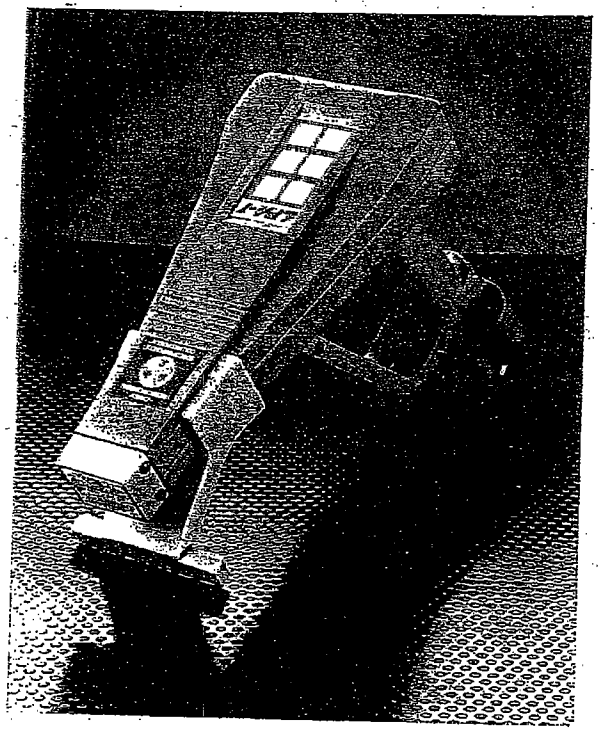
LPA-1
Lead Paint Analysis System
User's Guide



RMD Inc.
44 Hunt Street Watertown, MA 02172
1-800-LEAD RMD

The LPA-1 Lead Paint Analyzer

CAUTION: THE LPA-1 ANALYZER SHOULD BE OPERATED ONLY BY INDIVIDUALS WHO HAVE ATTENDED AND COMPLETED AN APPROVED LPA-1 OPERATOR TRAINING PROGRAM.

CAUTION: DISASSEMBLY OF ANY COMPONENTS, EXCEPT TO REPLACE THE BATTERIES, WILL VOID THE WARRANTY AND MAY LEAD TO UNNECESSARY RADIATION EXPOSURE.

The LPA-1 Analyzer contains radioactive material. This manual explains specific safety precautions and handling procedures for the LPA-1. When used in accordance with the procedures described in this manual, the LPA-1 poses no hazard to the operator or the environment. However, it is important to read and understand the information contained in this manual and to follow the appropriate procedures for the safe operation of this instrument.

If an LPA-1 Analyzer is damaged such that its mechanical integrity is suspect, contact a service representative immediately. If any hardware items are damaged, even if the system remains operational, contact a service representative at 1-800-LEAD RMD.

Oct 97 print

Please Enter Important Phone Numbers Below

Radiation Control Department: _____

Radiation Safety Officer: _____

Local Police: _____

Local Fire: _____

Manufacturer: RMD, Inc., (800) LEAD-RMD FAX (617) 926-9743
or (617)926-1167

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SPECIFICATIONS

DATA SPECIFICATIONS

Precision of Results

Wood, Drywall	±0.10 mg/cm^2
Concrete, Metal	±0.15 mg/cm^2

Accuracy of Results

Wood, Drywall	±0.10 mg/cm^2
Concrete, Metal	±0.15 mg/cm^2

OPERATIONAL SPECIFICATIONS

Depth of Measurement	3/8" Maximum
Substrate Effect	Automatic Compensation (Spectrum Analysis)
Detection Technique	X-Ray Fluorescence (XRF)
Radiation Source	Cobalt-57 (Min. 10 mCi, Max. 12 mCi)
Weight	Less than 3 lb. total (includes 1 battery pack)
System Battery Life	16 hours of normal usage before needing recharging
Battery Recharge	1.5 hours
Temperature	20-120°F

COMPUTER RECOMMENDATIONS

Hardware:
IBM Compatible 486/SX or higher
8 Meg of RAM
One unused RS232 serial port
COM1 or COM2

Software:
M.S. DOS 5.0 or higher
M.S. Windows 3.1 or higher

Note: The software will run on lesser systems however, performance may be slowed.

Part I

Background and Safety

A. INTRODUCTION

The LPA-1 Lead Paint Analyzer is a complete lead paint analysis system which quickly, accurately, and nondestructively measures the concentration of lead-based paint on surfaces. The LPA-1 system includes three main components: (1) The LPA-1 Analyzer, which is a portable analytical instrument operating on the principles of X-ray fluorescence. (2) A unique worksheet and clipboard, which allow for rapid and convenient recording of data. (3) Report generation software with an intuitive interface screen, which allows for efficient generation of reports integrated with measurement data; or as an option, the field report generation system. In addition, the LPA-1 system includes a carrying case, a battery charger, a spare battery pack, and a communication cable.

Each Analyzer contains a small, sealed radioactive source. The radiation emitted by the LPA-1, is substantially lower than is allowed by federal regulations. This manual provides the information necessary for the safe handling and reliable operation of the LPA-1 system. When used according to these instructions, the LPA-1 provides a fast and easy method for measuring lead in paint with no hazard to the operator or the environment.

B. X-RAY FLUORESCENCE

X-ray Fluorescence

X-ray fluorescence (XRF) is a common analytical technique used to quantitatively measure the concentration level of elements in solid or liquid materials. In this technique, the sample is bombarded by some form of ionizing radiation such as X-rays, or gamma-rays, which can cause the atoms of the sample to emit characteristic X-rays. These characteristic X-rays from the sample, known as the fluorescent X-rays, can be detected and analyzed to provide information as to what concentration of atoms are contained in the sample. Since this technique does not harm the sample in any way, it is considered a nondestructive testing technique and is attractive for many types of field measurements.

Atoms of every element emit a unique pattern of X-rays when they are excited by higher energy X- or gamma rays. The atom is excited when the primary bombarding radiation has sufficient energy to completely remove an electron from the inner shell of the atom. The atom then relaxes to its original states by emitting an X-ray with a specific energy level which is characteristic of that element. The characteristic X-rays are like finger prints of the various elements.

In atoms, electrons are arranged in several different energy levels, which are labeled K, L, M, N, etc. and each of these levels produces a separate set of X-rays. The K-shell corresponds to the most tightly bound electrons and produces the highest energy fluorescent X-rays. The L-shell corresponds to the second most tightly bound electrons and produces the second highest energy X-rays. Typically, the L-X-rays have only one-seventh as much energy as the K-X-rays and are often completely or partially

absorbed by other atoms in the sample before they can escape from the surface of the sample for analysis.

XRF is fast, requires no sample preparation, and is nondestructive. It was for these features that XRF was chosen as the basic principle for the LPA-1 Lead Paint Analyzer.

The LPA-1 implements the X-ray fluorescent technique by using a sealed radioactive source (Cobalt-57) inside the instrument to excite the atoms in the sample to produce fluorescent X-rays. When gamma-rays spontaneously emitted by the Cobalt-57 source strike the painted surface, lead atoms in the paint are "excited" and respond by emitting their own characteristic X-rays of unique energies. This response is known as fluorescence.

Inside the LPA-1 Analyzer is a special X-ray detector which senses the X-rays and determines what fraction of the rays have an energy which is characteristic of lead fluorescence. It is the output of this detector which is used by the Analyzer to measure the amount of lead in the sample.

While XRF is a rather sophisticated technical field, a detailed knowledge of XRF is not required by an inspector to obtain an accurate measurement of the lead content of a painted surface. However, for those desiring more detailed information, a number of good references on XRF are listed in Appendix I.

X-ray Fluorescence and the LPA-1 Analyzer

There are several important points to consider when working with the LPA-1 Analyzer. First, the LPA-1, unlike some other analyzers, relies on the measurement of the K-X-rays to determine the amount of lead present in the painted surface. Since the K-X-rays have higher energy than the L-X-rays and can penetrate further through the sample without being absorbed, the volume of

the sample which is interrogated by the Analyzer is relatively deep. This larger sample volume provides a more reliable and precise analysis than would be obtained with the lower energy, L-X-rays. Furthermore, unlike the L-X-rays, K-X-rays can penetrate many layers of paint and allow a good measurement of the lead content of paint to be made without being significantly affected by the thickness or number of layers of paint on the surface of the sample.

In addition, there is no common element present in paint that exhibits K-X-rays at an energy level close to lead K-X-rays. With L-X-rays there are many elements, such as zinc, bromine, arsenic, etc., who's K-X-rays are either identical or very close to lead L-X-rays. This phenomenon, which is known as "Matrix Effect", causes interference which requires judgment by the operator to discern between lead and interfering elements. The LPA-1 avoids operator judgment, which is subjective and may lead to error in actual lead evaluation.

The LPA-1 is a spectrum analyzer, meaning that it can reject the signal from X-rays of unwanted energies. Although the lead atoms emit X-rays at a unique energy, some of the gamma-rays emitted by the Co-57 "scatter" or bounce off the painted surface into the LPA-1 detector, and some of these rays have an energy close to that of the lead K-X-rays. This is called "Compton Scattering." The number of these scattered gamma rays depends very strongly on the nature of the substrate under the paint. For example, many more gamma-rays scatter off steel and concrete than scatter off wood or drywall. In order to compensate for this scatter, the LPA-1 measures the number of X-rays and gamma-rays at many energies and then automatically computes a correction for the substrate by mathematically separating the scatter contribution. This analysis of the energy spectrum means that the lead paint reading displayed by the instrument has been corrected

already for any substrate effects and no manual correction is required by the operator.

The LPA-1 has been designed to be sensitive only to lead within 3/8" of its sensor. Many K-X-ray measurements can be mislead by the presence of lead objects located deep within a wall, such as water pipes made of lead or lead solder on copper pipes. The LPA-1's field of view is limited to a maximum depth of 3/8", deep enough to handle virtually all painted surfaces, but not prone to detect lead objects located behind the surface.

While the statistical performance of the LPA-1 Analyzer, like any other XRF system, improves with longer measurement times, the LPA-1's design is so advanced that in most cases, it can provide statistically reliable readings for most measurements in only 2 to 4 seconds.

The Performance of XRF Analyzers

In order to understand how the performance of XRF analyzers is specified, it is important to define four important statistical concepts: precision, bias, accuracy, uncertainty. These concepts form the basis for the American Society of Testing and Materials (ASTM) recommended procedures for lead paint analysis.

Precision corresponds to random variations in readings and is a measure of reproducibility. If one were to place a 1.0 mg/cm^2 lead paint standard on a drywall and then take 10 readings, each for the same number of seconds, the readings would not be identical, but would have some spread due to the statistical nature of radioactivity. The term precision corresponds to the spread in identical readings under identical circumstances. Technically, it is the standard deviation of the measurements. The precision of the instrument will improve with longer measurement times. For

example, if the precision for readings taken with a 2 second measurement time is 0.2 mg/cm^2, it will be 0.1 mg/cm^2 for an 8 second reading and 0.05 mg/cm^2 in 32 seconds. Due to the effect of the scattered radiation, the precision of a reading for a given measurement period will also depend upon the substrate material.

The second important parameter used in evaluating the performance of a lead paint analyzer is accuracy. Ideally, if one were to take a large number of readings on a 1.0 mg/cm^2 standard sample, the average value of those readings would be 1.0 mg/cm^2. In the real world, the average would probably be a value somewhat different, such as 0.95 mg/cm^2. This difference between the average measured value of the lead content of a paint sample and its actual value is called accuracy, and cannot be corrected by taking additional measurements.

In addition, if one were to measure the 1.0 mg/cm^2 standard on a large number of pieces of drywall, then there would be some variation in the averages, due to small systematic errors present in any instrumentation. The variation in the average readings does not depend upon the time, but is fixed for a given XRF analyzer.

The third parameter to be considered in performance of a system is bias. Bias is the difference between a system reading on a painted surface (substrate) and an expected zero value. A reading greater than zero on a specific substrate is called "Positive Bias." A reading less than zero on a substrate is called "Negative Bias" for that substrate. The bias depends on the substrate material, due to the scatter effects discussed above. For the LPA-1, the bias which has been measured in thorough field testing is virtually zero.

The fourth parameter is uncertainty or confidence level. For any given reading, there is some uncertainty in the reading which is a combination of the precision and accuracy of the reading. The

total uncertainty for the LPA-1 Analyzer is a function of time and of substrate material. For example, for a 4 second reading on wood the total uncertainty is 0.50 mg/cm^2, while for a 15 second reading on wood the total uncertainty is 0.30 mg/cm^2. Although the uncertainty improves dramatically with time, it never goes to zero.

According to HUD guidelines, a lead measurement requires that a reading be taken with a 95% confidence level. This means that the actual measured lead value must exceed the regulatory action level by at least twice the uncertainty to be considered valid. Uncertainty is not a constant value, it depends on time, substrate and the actual lead concentration. The LPA-1 automatically, in Quick Mode, incorporates all of these factors to yield 95% confidence readings

All measurement systems possess some random and systematic errors. For the inspector, it is important to have the quantities specified and characterized in order to understand the reliability of the results (See Section F Understanding the LPA-1 Measurement Modes for a complete analysis of the LPA-1 uncertainty). It is also important to understand that the quality of the results improves with time, and that even at the longest times, there remains some uncertainty.

C. RADIATION SAFETY AND HANDLING PROCEDURE

Introduction

The LPA-1 Lead Paint Analyzer is a state-of-the-art analytical instrument used in quantitative analysis of lead in paint for various substrates used in commercial, industrial, and residential facilities. Radioactive material is used as the radiation source in this device for nondestructive method of sample analysis. The possession, use, transfer and disposal of this device is regulated in the United States by the individual States, the U. S. Nuclear Regulatory Commission (NRC), and the US Department of Transportation (DOT) and by other Regulatory Authorities outside of the United States.

Regulatory Responsibilities

The owner of this device must read and understand his/her responsibilities in accordance with the regulations of the state and the license issuing agencies. These responsibilities include:

1. To obtain, read and understand the sections of the State and Federal regulations which pertain to the proper use and possession of an isotopic radiation source that apply in the user's specific region of the country.
2. The owner must always know the whereabouts of this device.
3. The owner must assure that all labels affixed on the device at the time of arrival are maintained in legible condition.
4. The owner must provide a safe and secure area for storage of this device.

5. As explained in the leak test section of this manual, The owner must assure that the device is leak tested every six months and the required records are kept for the specified period.

6. The owner must not sell, transfer or lease this device without first ascertaining whether the regulatory authorities which have jurisdiction in either the owner's own region of the country or that of the intended recipient of the device require prior approval or notification and, if so, that such notification is given or such approval is obtained.

7. The owner must notify RMD and the authorities if this device is missing, severely damaged or involved in a fire, or if the result of the leak test proved to be in excess of the specified limits.

Safe Use and handling procedures

This device has been designed to operate with as low a radiation source as possible consistent with its ability to make measurements with high speed and accuracy. However, it is important for the user to understand that the radioactive source contained in the LPA-1 Analyzer emits radiation at all times and that even with the shutter closed, the device must be handled with radiation exposure in mind. Below are several recommended practices which should be followed to keep the radiation exposure for both the operator and others at a very low level.

1. Each operator should receive specific training in radiation safety before attempting to operate the device.

2. The device should be handled, stored and operated in such a manner as to minimize the amount of radiation exposure to both the operator and all other persons in the area.

3. The device should be stored in its factory supplied carrying case at all times when it is not in use.

4. The device should never be pointed at anyone, even with the shutter closed.

5. The stabilizer which fits on the front of the device should be left on at all other times except when making specific measurements on confined surfaces which require its temporary removal.

6. The device should always be held by the handle and not by the body or the tip.

7. The tip of the device should always be pointed away from the body and held at least 4" (10 cm) from it when being carried.

8. When the need to use both hands prevents the operator from holding the device by its handle, the device should be placed on the ground or some other flat surface. Under no circumstances should the device be rested or cupped against other parts of the body such as under the arm or on a leg. Similarly, the device should never be carried against the body in a pocket or in a pouch.

9. Since the radiation beam can penetrate for some distance into the surface being measured, care should be taken to ensure that no person is within one foot (30 cm) of the far side of the surface being measured.

10. The device is sealed at the factory and has no user adjustable parts. No attempt should ever be made to open the Analyzer for any reason.

At RMD, we try to provide our customers with all of the support and help needed for the safe operation of this device. Please do not hesitate to call us if you have any questions.

Leak Testing Procedure

Radiation Regulations require you, the user, as a licensee to test the device for leakage of radioactive material at no longer than six month intervals.

A leak test is conducted by wiping the surface of interest with a cotton swab and measuring the amount of radioactivity transferred from the surface to the swab. Under normal conditions, no measurable amount of activity is transferred.

To properly conduct the bi-annual leak test, it is best to procure a leak test kit from a commercial distributor who has approval to supply such kits to owner's region of the country. The leak-test kits should contain all of the necessary components including the swabs, moistening solution and container for returning the swab to the distributor who will measure it for radioactivity. The leak-test procedure used by the provider of the service must be sensitive enough to be able to positively detect .005 microcuries of radioactive material. A partial list of leak test kit distributors is provided in Appendix J.

Identification of the Surface of the Device to be Leak Tested.

Leak tests are generally performed on the surface of the device closest to the source. Since the user's access to the source housing is limited, the surface of the device which is both closest to the source and accessible is the front surface the Analyzer. This is the surface to be leak tested.

Procedure:

1. Make sure the shutter is closed and the manual shutter lock is engaged. Place the device on a table in a stable position and in such an orientation that it will be easy to wipe the swab against the front surface of the tip of the Analyzer.
2. Follow the leak-test kit distributor's instructions for preparing the swab.
3. Wipe the outside surface of the tip with the test swab in accordance with the wipe test kit instructions.
4. Prepare the swab for return to the distributor of the wipe test kit as directed.
5. As a licensee to possess and use radioactive material by your state, you, the owner, should maintain records regarding your leak-testing for the period specified in the state's regulations, typically 3 to 5 years. The information that should be maintained during the leak testing is:
   - Identification of the source and the device; manufacturer name, model number, serial number, isotope, quantity of the radioactive material.
   - Date of test and date of next scheduled test.
   - Information on the test method used: types of wipes such as, dry or wet.
   - Identification of the individual who performed the test. The first leak test should be performed immediately after the receipt of the device.

Leak Test Results.

In the unusual event that the result of a leak test indicates that the source is leaking, the owner should:

1. Immediately stop the usage of the device.
2. Assure that the device is maintained in a safe area.
3. Notify RMD within twenty-four hours and request an RMA number for sending the device back to RMD.
4. Notify your state's regulatory agency in US and the Regulatory Authorities in your country within three days.
5. Return the device in its factory supplied container.

Basics of Radiation Safety

Proper use of the LPA-1 requires a basic understanding of how radiation can affect the human body. The gamma rays emitted from the Co-57 isotope cause lead atoms in paint to fluoresce. These same rays can be damaging to body tissues. Fortunately, the amount of radiation involved with the LPA-1 is small and, with proper use, will expose the inspector to negligible amounts of radiation. However, it is still important to understand the overall health effects of radiation and, with that knowledge, strive for safer use of the instrument.

Health Effects

Radiation is pervasive in our environment. Although every person on earth is exposed to cosmic radiation, people living in different parts of the world experience different intensities of radiation. While one might initially believe that all radiation is harmful, there are many very important beneficial uses of radiation. For example, radiation is used for medical and dental diagnosis. These exposures to radiation have been carefully studied and analyzed to insure that they are well below levels which might be harmful to a human being.

Most people do not have exposures outside of the types just mentioned. However, those who work in industries in which

radioactive materials are used can experience somewhat higher exposures. Even in the case of a typical worker at a nuclear power plant, a work setting in which exposure to radiation is most likely, the total exposure is generally within safe limits. Since in any particular situation, there is the possibility of an accident or misuse of the radioactive material, it is important to understand the health effects of an overdose of radiation. This discussion is not intended to be alarming. Rather, it should encourage one to take the use of the instrument very seriously.

The radiation hazard is due to the fact that radiation can kill human tissue. The biological effects of radiation are burns due to localized high energy intensity beams, radiation sickness due to radiation received by the whole body, and at a higher level of radiation intensity, genetic mutations. Slight exposures to radiation are not cumulative but above a certain level of tolerable dose, they do have a cumulative effect and can produce permanent injury.

Time, Distance, and Shielding

Exposure to radiation can be minimized by three important considerations: time; distance; and shielding. The effect of the time of exposure is clear. The longer the exposure takes place, the more chance there is of damage to human tissues. However, a very large dose over a short period of time is generally more damaging than the same cumulative dose of radiation spread over a very long time.

The distance from a radioactive source is a second factor which affects radiation exposure. The intensity of radiation diminishes very quickly as one moves away from the source. Thus, distance is a very effective protection against harmful effects of radiation.

Finally, there is the concept of shielding. If a dense substance, such as lead or concrete, is placed between the source and an exposed individual, much of the radiation is absorbed by the barrier. This is why, for example, patients receiving dental X-rays have their bodies shielded with a lead blanket.

Understanding that these three physical means can affect the amount of exposure a person could have, provides a foundation of basic radiation safety procedures when using the LPA-1. In the LPA-1, there is a trigger which opens a shutter to allow the radiation to be emitted. The shutter should never be opened when testing is not being performed. Also, it should be understood that, even with the shutter closed, a very small amount of radiation is emitted. Therefore, if the instrument is not in use, it should be kept in its storage case (which provides some additional shielding). If the instrument will not be used at all, it should be stored at a safe distance and in its storage container.

These principles also apply to the safe transportation of the instrument. As a reminder, transportation of the LPA-1 must be in accordance with DoT and state regulations.

Radiation Exposure and the LPA-1

The LPA-1 should be considered in light of possible health effects. First, the activity of the Co-57 source is low (12 millicuries maximum), and the source is sealed in an airtight manner. Therefore, under normal use, the chance of radiation poisoning due to the radioactive material entering the body is virtually impossible. In addition, the source is housed in a tungsten shield within the instrument. It can only be exposed when the system is in contact with a surface. The low activity of the source and the shield, along with proper handling and operation results in no radiation hazard to the operator. The radiation dose equivalent

rate at the operator's hand is approximately 0.3 mRem/hr (millirem per hour) with the shutter open or closed. This is substantially below the permissible dose rate.

Despite the safety features, under no circumstances should an inspector or anyone else tamper with or attempt to replace the source. If the gamma ray emissions from the Co-57 isotope have diminished to the point of being inefficient in their operation, it is essential to return the instrument to the manufacturer to replace the radioactive source, and to carry out other functions such as preventive maintenance or re-calibration of the instrument.

Radiation Monitoring

Even with the safe use of radioactive material, the possible risk of exposure requires that workers be proactive in protecting themselves. Therefore, it is recommended that inspectors involved with the use of an XRF analyzer wear a dosimeter. A Dosimeter is a small device, usually containing a photographically sensitive material, which measures and records the amount of radiation to which the device, and therefore the person wearing it, is exposed.

There are two recommended types of dosimeters: rings and film badges. The ring may be worn on any finger while the badge is usually affixed to a piece of clothing in the area of the torso. The dosimeter is worn at all times during the use, transportation, or other potential exposure to radiation. At the end of a discrete period of time, usually one month, the dosimeter is returned to one of several commercial establishments which evaluate the amount of exposure that individual has obtained. A partial list of film badge distributors is provided in Appendix J.

Part II

Use of the Instrument

D. INSTRUMENT DESCRIPTION

The LPA-1 Lead Paint Analyzer is an instrument which quickly and nondestructively measures the concentration of lead-based paint on painted surfaces. The LPA-1 system includes three components: (1) The hand-held LPA-1 Analyzer XRF unit, (2) a clipboard and worksheets, which allow for recording of reading location data, and (3) a Report Generation Software with screen graphics which allows fast creation of Inspection Reports. In addition, the LPA-1 system includes a carrying case, microprocessor controlled Quick-Charge Battery Charger, a spare Battery Pack and Stabilizer, and a Data Communication Cable.

The LPA-1 Analyzer

The LPA-1 contains an electronics package that uses X-ray fluorescence technique to analyze the amount of lead in painted surfaces. The front part of the Analyzer contains a radiation source which irradiates the painted surface to generate characteristic X-rays. The LPA-1 also contains a rugged, solid state detector which senses the X-rays emitted by the target surface. The microprocessor analyzes spectral data, computes the amount of lead, presents it on the display and also stores it in the memory for future download to a personal computer.

Two optical proximity sensors at the front surface of the LPA-1 prevent the radiation shutter from opening if the Analyzer has not been placed flat against a surface.

The Analyzer has a measurement storage capability of up to 4,000 single measurements (not average sets), 1000 in any one job. Upon command, these measurements can be downloaded to a personal computer for easy creation of inspection reports.

The Worksheet and Clipboard

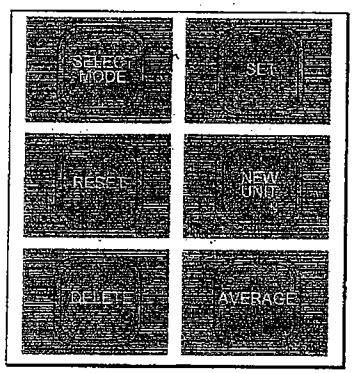
A belt mounted clipboard and worksheets are used to record the locations of measurements taken in the field. They are designed to allow the Inspector to make a measurement with one hand and record the reading location with the other, thus eliminating the need for a second person. An optional Field Report Generation System is also available as a replacement to the worksheets and clipboard.

Operating Modes

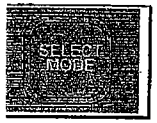
The LPA-1 can operate in either of two measurement modes, Standard Mode, or Quick Mode. In Standard Mode, the user chooses the measurement time. In Quick Mode, the measurement time is determined by the LPA-1 Analyzer to achieve a 95% confidence level measurement as compared to an action level. The time of measurement in Quick Mode depends on the actual lead level of the surface, the type of building material under the paint, the action level, and the age of the source. The action level can be set by the user from 0.4 mg/cm^2 to 2.0 mg/cm^2 and is programmable in increments of 0.1 mg/cm^2.

E. GUIDE TO LPA-1 CONTROLS

There are only six control keys to learn on the LPA-1. Some keys have more than one function. The key pad located on the top of the instrument is diagrammed below.



LPA-1 Keypad Controls



SELECT MODE KEY

Primary Use- To select Standard Mode or Quick Mode

Secondary Use - To turn on and off Screen Saver Option

In Detail

The SELECT MODE key allows the user to toggle between Standard Mode and Quick Mode. Standard mode is used primarily for calibration checks. Quick Mode is the recommended mode of

operation for inspections. In addition the SELECT MODE toggles on and off screen saver option, which was designed to increase the time between battery charges.

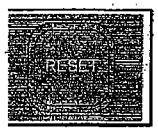
Operation

To Set the LPA-1 Mode of Operation

1. Pull the trigger briefly to obtain a READY message.
2. Press the SELECT MODE key. The LPA-1 will display either 'QUICK MODE' or 'STD MODE XX SEC' depending on the present setting.
3. Each further press of the SELECT MODE key causes the Analyzer to toggle between the two modes.
4. When the Analyzer displays 'STD MODE XX SEC', the measurement time can be changed by pressing the SET key. The time will be incremented in steps from 5, 10, 20, 30, 40, 50, and 60 sec. After 60 sec the cycle starts over at 5 sec.
5. If the analyzer is in Quick Mode, the Abatement Level can be adjusted by pressing the Set key. The LPA-1 will then display 'ABATE AT XX mg'. The Abatement Level can then be adjusted between 0.4 mg/cm^2 to 2.0 mg/cm^2.
6. In either mode, the user prompt will be held on the screen for 3 seconds after the last key entry, after which the selected mode is saved and the system returns to 'READY'.

To Toggle On and Off the Screen Saver Option

1. Let the LPA-1 power off
2. Wake up the instrument by holding down the SELECT MODE key for two seconds to get the message CONFIRM SET MODE
3. Confirm using the SET key
4. Use the SELECT MODE key to toggle between SCREEN SAVER and SCREEN NORMAL operation
5. Wait until the instrument goes back to READY. The mode has been selected and the instrument is ready for use.



RESET KEY

Primary Use- To cancel all measurements in the LPA-1 memory. USE WITH CAUTION!

In Detail

The LPA-1 keeps track of Job and Unit numbers. The RESET key clears both of these values to zero and should only be used after all data has been transferred to the computer. Since this function also erases all stored data, it is important that it never be used in error. The RESET key does not change the programmed values of time and abatement level. *NOTE There is no way to recover data erased by the Reset operation.*

Operation

1. Pull the trigger briefly to obtain a 'READY' message.
2. Press the RESET key. The Analyzer will display 'CONFIRM RESET'.
3. Press the SET key to confirm the request to reset, If not confirmed, the request will be ignored.
4. Upon Reset, the display will show the message 'RESET' for 3 seconds, after which the system returns to 'READY'.

DELETE KEY

Primary Uses- To recall and/or erase the last reading in memory. Delete a set of readings while in AVE Mode. To put the LPA-1 into JOB SCAN MODE Secondary Use- To decrement the settings when in SET TIME mode. To scan backwards in JOB SCAN MODE

In Detail

The DELETE key allows the user to view and/or delete only the most recent measurement or average set. It requires a confirmation step to delete the reading.

In Addition DELETE activates JOB SCAN MODE. Job Scan Mode allows the user to review measurements taken in the current job on the screen. The readings may be observed without changing them.

The DELETE key can also be used to display the most recent measurement. This can be achieved by pressing DELETE once and not confirming the entry.

Operation

To Recall or Delete The Last Reading or Set of Average

1. Pull the trigger briefly to obtain a 'READY' message.
2. Press the DELETE key. The Analyzer will display the most recent measurement. (If there is no reading in the current job, the LPA-1 will display DELETE DENIED.)
3. Press the SET key to confirm.
4. The display will show READING DELETED.

NOTE: In average mode the entire set of average readings is deleted and "DELETE AVE SET" is displayed which is then confirmed by the SET key.

To Enter and Use Job Scan Mode:

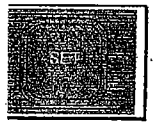
1. Let LPA-1 power down.
2. Wake up the instrument with the DELETE key, holding the key down for 2 seconds then letting go.
3. The unit will give the message "Job Scan Mode" for 2 seconds, then will display the last reading in the current job.

The Job Scan Mode has been selected and the instrument is ready to scan the measurements

To Scan Backward: While in Job Scan Mode hold down the DELETE key. The readings will slowly scroll down toward the beginning of the job. To speed up the scan, press and hold either the NEW UNIT key or the RESET key while holding down the DELETE key.

To Scan Forward: While in Job Scan Mode hold down the AVERAGE key. The readings will slowly scroll up toward the end of the job. To speed up the scan, press and hold either the NEW UNIT key or the RESET key while holding down the AVERAGE key.

To Exit Out of Job Scan Mode: To Exit press the SET key or pull the trigger to take a new measurement at any time. Upon exiting the Job Scan Mode, the LPA-1 will automatically return to the last reading taken.



SET KEY

Primary Uses- To set abatement level when in QUICK MODE. To confirm RESET, DELETE, NEW UNIT, AND SET CLOCK. To set measurement time

when in STANDARD MODE. To set the number of readings in an average group.

Secondary Use- To put the LPA-1 in to DATA TRANSFER MODE

In Detail

The SET key is used to program the value of the abatement level when in Quick Mode. Abatement Level can be set in increments of 0.1 mg/cm^2 to a maximum of 2.0 mg/cm^2. At that point, the value rolls over to 0.4 mg/cm^2 again. In Quick Mode, the Analyzer uses the abatement level to determine the measurement time required for 95% confidence. The Abatement Level programmed into the LPA-1 is downloaded to the Report Generator and also appears in the Inspection report that is printed. In Standard Mode, the abatement level is not used directly but is still printed in the final report. For that reason, it is important to enter the correct abatement level in both modes. In Standard Mode, the SET key is also used to increment the reading time. The time may be set from 5 seconds to 60 seconds. In Average Mode the SET key increments the number of readings in a set of averages.

The Set key also has two other functions. It is used to put the instrument in DATA TRANSFER mode so that it can download the measurements to a personal computer. It is also used as the CONFIRM key with certain functions such as resetting the system, starting a new unit, changing the time, etc.

Operation

To Change Abatement Level

1. Briefly pull the trigger so that the LPA-1 goes to READY.

2. Press the SET key, to display ABATE AT XX MG.
3. Each further press of the SET key will cause the Analyzer to increment the value. The message will be held on the screen for 3 seconds after the last key entry, after which the last displayed value will be saved in memory. The system will then return to READY.

To Confirm Other Keypad Functions

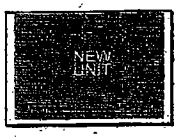
The SET key is also used in response to the message "CONFIRM XX". In this case, a single keystroke indicates confirmation. For example, to delete a reading, press the DELETE button, at the message, 'CONFIRM DELETE' press the SET key.

To Go to DATA TRANSFER Mode

1. Allow the unit to power down.
2. Press the Set key for three seconds.
3. The LPA-1 will display DATA TRANSFER.
4. The DOWNLOAD button on the Computer Screen can then be clicked on with the mouse.
5. Once the transfer is complete, the LPA-1 can be returned to the READY mode by pressing the SET key for two seconds.

To Set the Sample Time in Standard Mode

1. Press the trigger briefly to wake up the LPA-1.
2. Press the SELECT MODE button. The LPA-1 will display STD MODE XX SEC, where XX is the Standard Mode measurement time.
3. Press the SET key as many times as necessary to reach the desired sample time.
4. When the LPA-1 shuts off, the setting will be saved.



NEW UNIT KEY

Primary Uses- To create a new job. To display the current Unit and Job numbers.
Secondary use- To set the LPA-1 clock

In Detail

The LPA-1 system records readings in sequence for each particular housing "Unit". Each Unit is assigned a unique Job Number, which is created from the date and military time at which the inspection began. For example, a Job Number 01-19-94-0945 (01/19/94 09:45) indicates that the inspection began on January 19, 1994, at 9:45 am. This number is used by both the Analyzer and the Report Generation Software to identify inspection jobs.

In addition to the Job number, the LPA-1 also creates a Unit Sequence number. This number may be saved if desired on the worksheets created in the field. This number is displayed on the LPA-1 screen as UNIT XX where the XX is 1, 2, 3, or however many units have been started since the last System Reset has been performed.

The Unit number is provided as an aid for dealing with large numbers of jobs in a single download. It's easier to remember that Units 1, 2, and 3 in a sequence of jobs were for a particular customer than to trying to recall that they were Job numbers 1119951454, 1119951630, and 1120950821. The NEW UNIT key creates a division marker in the string of readings stored in the LPA-1 memory that allows the Report Generation Software to identify the end of one inspection job and the start of the next. The NEW UNIT key also creates a new Job Number for entry on the field record worksheets. Since implementing this function at the incorrect time would terminate the current job, a second key (SET) must be pressed to confirm its activation.

Operation

To advance the UNIT and JOB numbers

1. Pull the Trigger briefly to obtain a 'READY' message.
2. Press the NEW UNIT key two times.
3. The message CONFIRM NEW UNIT will be displayed.
4. Press the SET key to confirm the request to create a new Job number.
5. The Analyzer will display the next Unit Number followed by the new Job Number before returning to 'READY'. The Job number should be noted on the worksheet.

To find out the current UNIT and JOB numbers.

1. Pull the Trigger briefly to obtain a 'READY' message.
2. Press the NEW UNIT key.
3. The Analyzer will display the current Unit Number for 3 seconds and then the current Job Number for 5 seconds. (If no further keypad entry is made, it will then return to READY.)

To Set the Time

NOTE: The clock is a critical part of the LPA-1 Analyzer system. The correct time and date are used to generate the individual job numbers which are used by the report generating software. They are also used by the LPA-1 to calculate source half-life correction factors when taking measurements in both Quick Mode and Standard Mode.

Operation

1. Allow the LPA-1 to power down.
2. Press the NEW UNIT key and hold for two seconds.
3. The message CONFIRM SET TIME will appear. This is the SET TIME mode.
4. Confirm the request by pressing the SET key.

5. The time and date will then be displayed in the format Month-Day-Year-Time. The time is based on a 24 hour clock.
6. Use the SELECT MODE key to move the cursor between the date and time items.
7. Use the AVERAGE key to increment and the DELETE key to decrement the digits.
8. To exit SET TIME mode, press the NEW UNIT key.
9. The unit will then display CONFIRM SET TIME.
10. Confirm with the SET key.

AVERAGE KEY

Primary Use- To turn AVERAGE on and off

Secondary Use- To increment the settings when in SET TIME mode. To scan forward in JOB SCAN MODE.

In Detail

The AVERAGE key is used to allow the operator to increase the statistical confidence of a measurement through the averaging of additional measurements. While acquiring a measurement in Average, the LPA-1 will display the following messages: In Standard Mode 'X SEC Y OF Z' where X is the measurement time, Y is the current reading in the average set and Z is the total number of readings in the average set (30 SEC 1 OF 3). In Quick Mode, QMODE Y OF Z, where Y and Z are the same as Standard Mode.

At the end of a set of averages the LPA-1 calculates the average of the readings and displays it for 5 seconds. The LPA-1 does not save the calculated average. After download, all measurements taken in average mode will be treated as a single

set, the average of which will be computed and printed by the Report Generation Software. *The Report Generator shows all the individual readings taken as well as the average of the group.* The LPA-1 assumes that all points in an average set have been taken at a single physical location in the building and prevents the Report Generating Software from assigning more than one location to the set.

Operation

To start Average Mode

1. Pull the trigger briefly to wake up the LPA-1.
2. Press the AVERAGE key. The instrument will display AVERAGE OF X where X is the number of readings to be averaged.
3. Press the SET key to increment the desired number of readings to average (2-9). After 9 the cycle starts again at 2.
4. Press the AVERAGE key or pull the trigger to accept the settings, otherwise the LPA-1 will return to the READY mode after 5 seconds with out activating the average mode.

To leave the Average Mode

After the final measurement, press the AVERAGE key to display the message 'AVERAGE OFF.' The system will then return to READY.

OTHER CONTROLS

THE TRIGGER

The TRIGGER is used to wake up the Analyzer if necessary and also to start the measurement cycle. When the TRIGGER is

pulled, the Analyzer checks for the presence of a surface, then starts the measurement.

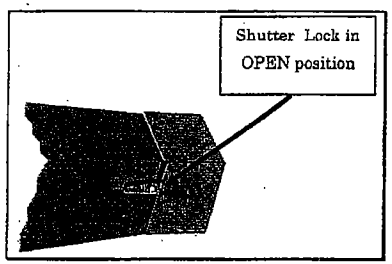
Operation

When the Trigger is pulled, the LPA-1 will begin a measurement. If the Analyzer is in the Standard Mode, it will display 'XX SEC MEASUREMENT'. When in Quick Mode, it will display a series of intermediate measurements. At the end of the measurement, the Analyzer will display the Measurement Number and Lead Content such as **#24 1.2mg/cm^2**.

If the TRIGGER is pulled when the Analyzer is not flat against a surface, the display will indicate 'NOT FLAT'. As a safety feature, if the TRIGGER is released or the instrument is removed from the surface during the measurement, the measurement will terminate. The display will show ABORT in Standard Mode or prior to the inconclusive signal in Quick Mode. In Quick Mode, the reading will be saved as inconclusive if the inconclusive signal has sounded (some time after 30 seconds)

MANUAL SHUTTER LOCK

As a safety feature, the LPA-1 Analyzer includes a MANUAL SHUTTER LOCK. **The shutter lock should be activated if the message SHUTTER STUCK ever appears on the Display screen.** This message would indicate the possibility of a serious system malfunction and the instrument should not be used until the factory is consulted. The Shutter Lock should always be used during transportation of the unit.



The unit will not operate if the manual lock is on and will display the message 'SHUTTER LOCKED' when an attempt to take a measurement is made.

Operation

The Manual Shutter Lock is activated by slipping off the stabilizer and turning the lever located on the bottom of the Analyzer near the front of the unit to the locked position. The shutter is unlocked when the lever is pointed toward the trigger and locked when it is pointed 90 degrees away from the trigger.

F. CONCEPTS OF LEAD PAINT MEASUREMENTS

Types of Error

An XRF measurement for lead content requires an evaluation of a condition as it relates to some regulatory level. The objective is to determine whether the lead content is positive or negative when compared to the regulatory level (abatement level.) There is no absolute measurement possible either by XRF or laboratory analysis. All methods have errors or tolerances associated with them.

Two types of error can influence a measurement, random error and systematic error. Random errors are those that are known but can not be influenced or eliminated, such as the effect of radioactive material in XRF. Systematic errors are those that can be influenced and reduced but many times not completely eliminated. These errors include substrate effects, operator error, calibration samples, and others.

XRF measurements are influenced by both random and systematic error, and the contribution of both must be accounted for as the confidence, or uncertainty, of a particular reading. The graph, shown on page 46, gives the 95% statistical confidence of the LPA-1 As the graph shows there is not a single value for the uncertainty of the instrument. Rather the uncertainty, or confidence level is a function of time, substrate, and lead content. Each curve shown on the graph is a summation of random error (which decreases with time) and systematic error (which remains fairly constant over time) for a given substrate.

Some Important Terms

There are a few important concepts used in the next sections of this manual that should be clearly understood by the LPA-1 operator.

Accuracy- Accuracy is the difference between a reading average and its true value. Accuracy represents the influence of systematic error. An accurate series of readings is one in which the average is close to the actual value of the lead. For example, if an XRF instrument was used to take a series of readings on a 1.02mg/cm^2 NIST standard, and produced the numbers 1.0, 0.5, 1.5, 2.0, 0.0, the average would be 1.0 and the readings would be considered accurate even though the readings are not close to each other.

Precision- Precision represents the degree of reproducibility. It accounts for the contribution of random errors on a measurement. A precise series of readings is one in which the readings are close together. In the example of accuracy above, the readings were accurate but not precise. If an instrument on the same 1.02 standard was used to take the series of readings 1.0, 1.2, 1.1, 1.2, 1.1, the average would be 1.12. The results would be more precise but not as accurate as the first series taken above.

The ideal condition is to have an instrument that is both precise and accurate.

G. UNDERSTANDING THE LPA-1 MEASUREMENT MODES

What is QUICK MODE?

In general, QUICK MODE is a productivity tool for use by Lead Paint Inspectors in the field. The concept of Quick mode is to achieve a 95% confidence level for a measurement in the shortest possible time. **With the exception of calibration checks, Quick Mode is the recommended mode of operation.** The only requirement of the operator in Quick Mode is that the correct abatement level be entered into the analyzer before the job begins. ***In Quick Mode, once the abatement level is set, the unit seeks the shortest period of time to assure a positive, negative or inconclusive measurement with 95% confidence. This is for any condition, compared to any abatement level.***

QUICK MODE and Statistical Confidence

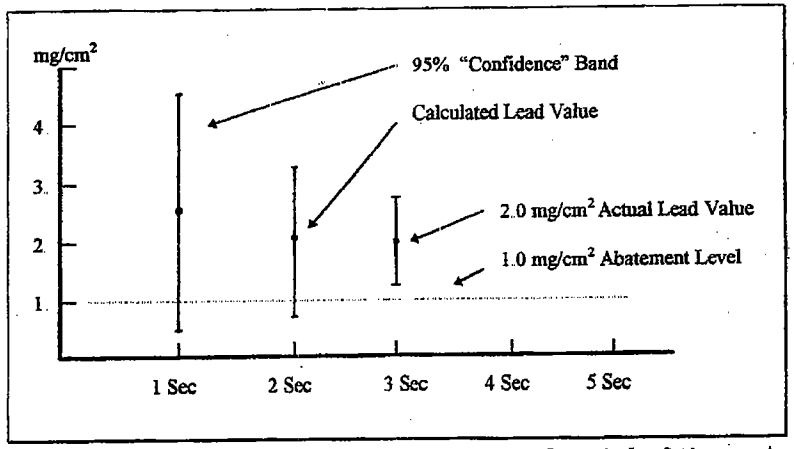
The precision of a lead measurement made by any XRF analyzer is a function of the length of the reading. This is due to the random nature of the radioactive material which is used to induce X-ray fluorescence. Fluorescence of materials occur and are detected at random rates, slight variations do occur between multiple readings of the same sample. By collecting more data a closer match, between the measured spectral shape and the true spectrum of the material being scanned, results. Therefore, longer measurements yield readings with tighter precision.

The reading time required to determine positive or negative lead varies depending on the action level and the actual amount of lead on the surface being measured. For example, if the abatement level is 1.0 mg/cm^2 and the amount of lead on a surface being read is 1.1 mg/cm^2, an XRF measurement would require tighter precision to make a determination, therefore a relatively long reading would be required. If, however the amount of lead being read was 5.0 mg/cm^2, a less precise reading could be used to determine whether the surface is actionable. This means that a relatively fast reading would be adequate. Thus, by answering the question, "Is this surface positive, negative or inconclusive?" **as each reading is in progress**, Quick Mode can dramatically reduce the time to perform an inspection job. In it's simplest form, this is the concept of Quick Mode.

The actual operation of Quick Mode is a bit more sophisticated because the statistical confidence of the reading must also be assured and that is dependent on some other factors. For example, the precision and accuracy that can be achieved for a lead paint measurement is also a function of the building material under the lead paint. The precision of measurements on wood are tighter than on steel for the same period of time. The QUICK MODE performs an analysis of the spectral information, recognizes the substrate and adjusts the measurement time as required. In STANDARD MODE if the user wished to take a reading for exactly the minimum amount of time needed to determine actionability, he would have to correct for the composition of the substrate material, the age of the source, the abatement level, the number of counts acquired by the XRF instrument and allow enough time to assure that the desired statistical precision has been achieved. This is a difficult task for an operator to perform manually. By selecting **Quick Mode** however, the user can have the LPA-1 automatically perform this task for him.

How To Interpret a QUICK MODE Measurement

The figure below represents a single measurement divided into three parts. In this example, the actual lead content of the surface is 2.0 mg/cm^2. The Abatement level is 1.0 mg/cm^2. After the first second the LPA-1 reviews the spectral information and determines the type of substrate or building material being analyzed. It also considers a the number of spectral X-ray florescence data lines detected during this first period. With this information the LPA-1 "knows" what level of confidence to add and subtract from the measurement to determine a band of readings to achieve 95% confidence. This is shown as the area around the first period's measurement. Notice that the range of possible lead value after the first period includes values above and below the abatement level. No conclusion as to action can be made at this point, so more data must be taken.



The same analysis occurs after the second period of time. As seen in our example, the result of the second, although producing a tighter spread of probability around the measurement, still shows the slight possibility of a lead level below abatement level. The third measurement period shows that for the level of confidence programmed into the LPA-1 (95%), the lead level in our example is definitely above the abatement level. The instrument will terminate the measurement at that point and display the result.

The result of any measurement made in Quick Mode is limited to one of three possibilities. 1) Positive lead level, 2) Negative lead level, or 3) Inconclusive result. Positive results are displayed as any measurement above the abatement level. In addition the red positive light will flash on the front of the instrument. Negative results are recognizable as displayed measurements that are below the abatement level. In those cases the green negative light will flash on the front of the instrument In cases where the measured lead level is too close to the action level to reach a determination in 60 seconds, *the Analyzer will end the measurement by displaying the action level and both the positive and negative lights will flash. This is an indication of a Inconclusive Measurement.* Positive and inconclusive measurements will appear on the Summary Sheet of possibly actionable readings created by the Report Generator.

The decision of what is considered to be positive negative or inconclusive is based on the action (abatement) level set by the user. For example the abatement level in some areas of the country is 0.5 mg/cm^2, while other areas are 2.0 mg/cm^2. It is quite possible to get a reading, such as 1.1 mg/cm^2, that is abatable in one area of the country but not in another. In either case setting the action level accurately, is critical to determining a proper conclusion in QUICK MODE.

Stopping an Inconclusive Reading Early in QUICK MODE

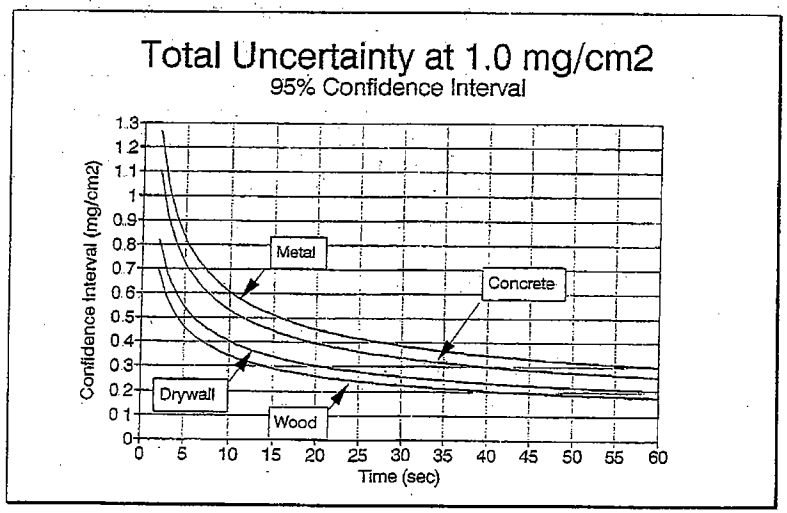
After a Quick Mode reading has run for about 30 seconds, the LPA-1 performs a calculation to determine if the reading is likely to run for a full 60 seconds and still result in an inconclusive reading. If this is determined to be the case, the Inspector has the option of ending the reading early. As a signal to the Inspector, the instrument emits a beep and the inconclusive light comes on at the front of the instrument. Any time thereafter, the Inspector may end the reading by releasing the trigger. The reading value will be stored as the abatement level, indicating that the reading is inconclusive. If the trigger is released before the beep and light , the LPA-1 will display ABORT and the reading will not be saved.

What is Standard Mode?

Standard Mode allows the user to acquire a measurement for a fixed amount of time. This is the typical method of operation for most XRF instruments used for lead paint inspection on the market today. With the LPA-1, this is the mode of operation most useful for verifying calibration against a lead standard, or for situations where the user may want a longer reading than may be required to validate a positive or negative lead condition. An initial site survey may be such a case.

For any given reading in standard mode, there is some uncertainty in the reading which is a combination of precision and accuracy. The total uncertainty for the LPA-1 Analyzer is a function of time and of substrate material. Although the uncertainty improves with time, it never goes to zero. According to the proposed HUD guidelines, a lead determination requires that the reading be taken with a 95% confidence level. This means that the actual measured lead value must exceed the regulatory action

level by at least twice the uncertainty. The plot shows the LPA-1 uncertainty for 95% confidence readings. For example, assume that an inspector measured 1.6 mg/cm^2 of lead in 15 seconds on drywall. Since the uncertainty shown in the plot is 0.35 mg/cm^2 in 15 seconds, this reading is 1.6 ± 0.4 mg/cm^2.



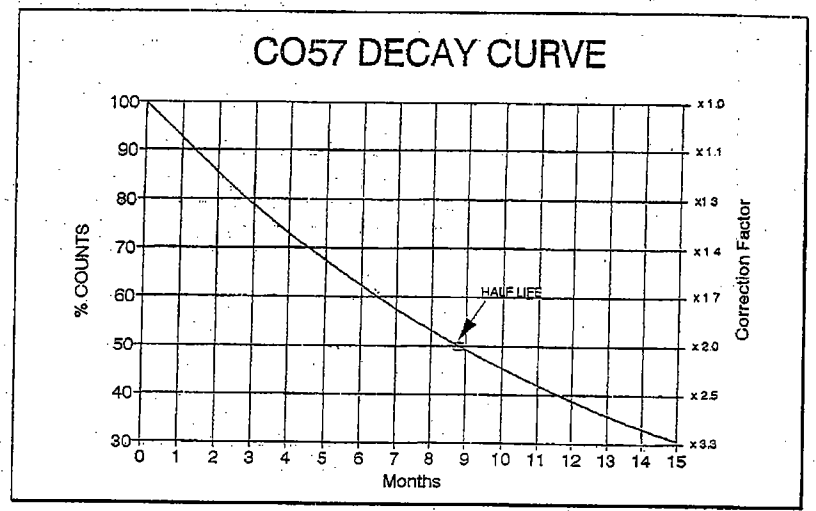
The length of reading programmed by the user in Standard Mode is not corrected for the decay of the source and must be lengthened as the source ages to maintain the same statistical accuracy. Use the source decay chart to determine the appropriate correction factor.

Use Standard Mode When it Makes Sense

Occasionally there will be jobs in which most or all of the lead readings are close to the action level. The LPA-1 analyzer in Quick Mode may find these conditions to be inconclusive and take to 60 seconds of measurement before displaying the abatement

level. In this case, it may be faster to set the LPA-1 to STANDARD MODE and select a half-life time corrected measurement period based on the required uncertainty specified for the Job.

The operator should choose a Standard Mode setting using the



decay and uncertainty curves shown. For example, if the uncertainty at 95% confidence on wood for a particular job is +/- 0.35mg/cm^2, the time required for a reading with a new source would be 10 seconds as given by the Uncertainty Graph below. If the source is 270 days old the reading time correction would be **x2** as given on the decay curve above. Therefore the required reading time on wood would be 20 seconds for a source that is nine months old or 10 seconds for a new source. The readings will still be inconclusive within the +/-0.35 mg/cm^{2}and must be recorded as such, but the operator will achieve this conclusion in 20 second rather than the 60 seconds it would have taken.

Reading Confidence vs. Time

Suppose an LPA-1 was used to take a series of readings in Standard Mode at five seconds, then Quick Mode was used to take a series of readings on the same surface. If the readings taken in Quick Mode results in an average reading time of 3 seconds, the spread in measurements would be wider in Quick Mode because the measurements were taken in less time. Conversely, if the average reading time for the Quick Mode readings was 8 seconds, the spread would be smaller for the Quick Mode measurements. The difference is that in Quick Mode, 95% confidence is assured.

H. INSPECTION PROCEDURES

Beginning of Work Session

At the beginning of the work session, be sure that there is a fresh battery pack in the Analyzer. It is a good practice to transfer previous data to the personal computer before beginning the day's work. If the previous data have not been transferred, refer to the software manual. If the data has been transferred, reset the Analyzer memory by pressing the RESET button. The SET button confirms the reset.

Verify Keypad settings

Before taking any measurements, a few system configuration checks should be made;

1. Check that the Manual Shutter Lock and Key lock are unlocked.
2. Check that any old data in the LPA-1 has been downloaded if a Memory Reset is to be performed.
3. Check that the Abatement Level is properly set. The Abatement Level setting can be checked by turning on the LPA-1 with the Trigger, then pressing the SET key. The LPA-1 will then display ABATE AT XX mg. If the setting is not correct, the value can be incremented with the SET key from 0.4 to 2.0 mg/cm^2.
4. Verify that the LPA-1 is in the desired operating mode. When in Standard Mode, the display will show STD MODE XX Sec, where XX is the number of seconds previously programmed for the length of the measurement. If a Quick Mode measurement is desired, change operating modes by pressing the SELECT MODE button.
5. Verify the setting of the LPA-1 system clock by allowing the LPA-1 to power down, then pressing the NEW UNIT key for two seconds. Press the SET key to confirm. The display is formatted as, month-day-year-time. The time should be accurate within 15 minutes. To exit this mode, press the NEW UNIT key again and allow the LPA-1 to shut off.

Check Calibration Sample

Before and after each Job, it is good quality control practice to do a system performance check. It is recommended that this be done by taking three readings on the Calibration Test Block provided with the instrument and on another lead free wood block. The tested value of the calibration test block is recorded on the back of the block. A reading of appropriate length (see below) should be taken on both the Calibration Block and also on any block of unpainted wood or drywall that the user has at hand to provide a zero lead reference. *Note: The back side of the calibration is not a good zero reference because some amount of the lead on the front of the block is liable to be detected through the thin wood block.* For jobs which contain an abundance of one kind of substrate (such as steel or concrete) it is a good idea to do a calibration check on that substrate.

Use the Date of Receipt of the LPA-1 from the factory as a starting point to correct the Performance Test reading for half-life decay as follows:

0 to 120 days (4 mos.)- Test at 30 seconds

121 to 175 days (6 mos.)- Test at 40 seconds

176 to 270 days (9 mos.)- Test at 50 seconds

270 to 455 days (15 mos.)- Test at 60 seconds

Beyond 15 months-Time to replace the Source.

95% of the time, the value of any single calibration reading should be the value of the calibration block +/- 0.3 mg/cm^2. Note reading times can be achieved by averaging shorter time frames. For example, one 60 second reading is equivalent to the average of two 30 second readings or six 10 second readings.

Alternately the user may wish to perform 60 second measurements throughout the life of the source. This eliminates guesswork and keeps field procedures simple. In this case, the user should expect to see readings that are the value of the calibration block +/- 0.2 mg/cm^2 with a new source on wood.

If the Lead Readings are outside of the correct range, wait at least five minutes for the Analyzer's automatic Calibration Check to occur. After the Check is completed, reread the Standard Block. Should the readings again fall outside the acceptable range, call RMD before continuing with the inspection.

Preparing To Inspect The First Unit

The LPA-1 system records the readings in sequence for each particular housing unit. Each unit is assigned a unique Job Number, which is created from the date and time at which the inspection began. For example, a Job Number 01-19-95-0945 (01/19/95 09:45) indicates that the inspection began on January 19, 1995, at 9:45 am. This number is used by both the Analyzer and the Report Generation Software to identify inspection jobs.

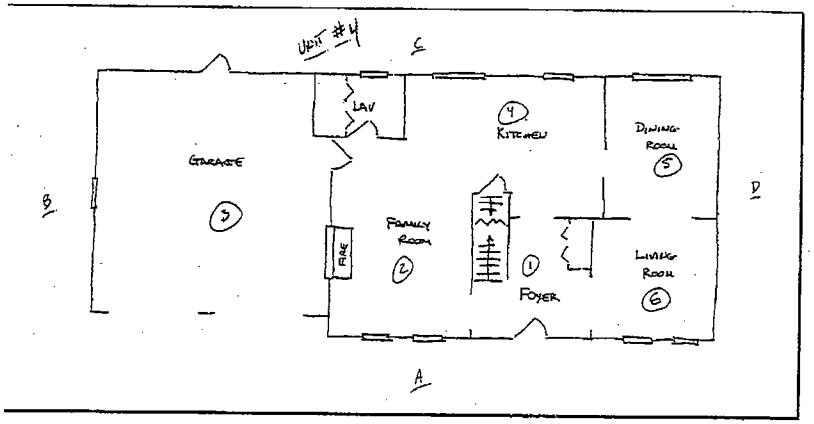
In addition to the Job number, the LPA-1 also creates a Unit Sequence number. This number may be saved if desired on the worksheets created in the field. This number is displayed on the

LPA-1 screen as UNIT XX where XX is 1, 2, 3; or however many units were started since the last System Reset.

The Unit number is provided as an aid for dealing with large numbers of jobs in a single download. It's easier to remember that Units 1, 2, and 3 in a sequence of jobs were for a particular customer than to trying to recall that they were Job numbers 1119951454, 1119951630, and 1120950821. In addition, the Report Generator screen will show the same Unit Number for the convenience of the user when scrolling through the downloaded jobs.

In order to find out what the current Unit Number is from the LPA-1, pull the trigger briefly to wake up the LPA-1, then press the NEW UNIT key once. The unit number displayed is the current unit.

Both the Unit and Job Numbers may be incremented by using the NEW UNIT button described in Section E. The address of the unit and the new Job and Unit number should be entered on the first new worksheet. A calibration check (as described earlier) should be performed at the beginning and end of the inspection and recorded on the work sheet.



The first step in conducting an inspection is to make a floor plan map of the housing unit which will be used in generating the report. The figure above is an example of such a map. Note that the walls are designated as A, B, C, and D. In all rooms, the A wall is either the address street side or the entry side of the unit. The B, C, and D walls are in clockwise order from the A wall. Some jobs have their own requirement for wall designation. What ever the method used for designating walls, it should at least be consistent.

Each enclosed space, such as a closet, should be considered a separate room. Oddly shaped rooms may also be partitioned into rectangular sections for ease in record-keeping. Once the map is complete, each room in the unit can be numbered immediately or done as the inspection proceeds. The map may then be placed into the clipboard under the worksheet pad and the clipboard placed onto its belt and pulled into position as a work table.

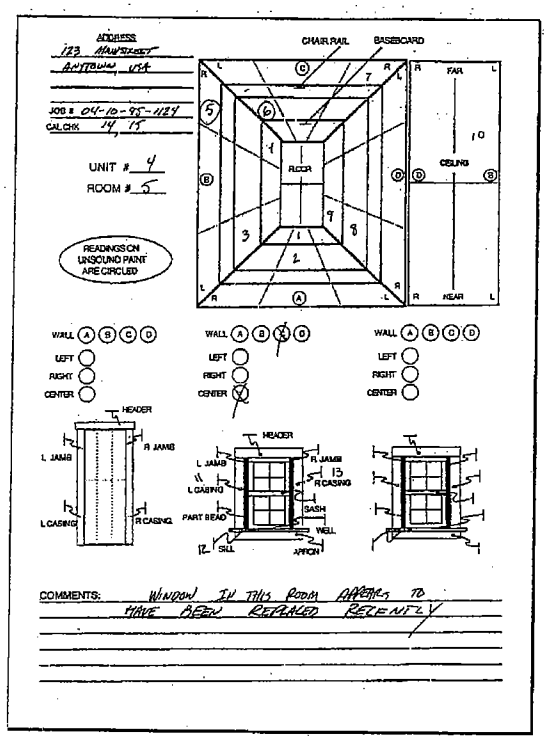
On the top worksheet, enter the address of the unit to be inspected. Press the NEW UNIT button and confirm a new unit, then record on the worksheet the Unit Number and Job Number which are displayed on the Analyzer. Enter on the worksheet the Room Number, taken from the map, the name of the room along with any observation about color, substrate, and condition of paint.

Taking Readings

Once the proper information is recorded on the worksheet and the calibration check completed, the system is ready to obtain readings. Place the Analyzer flat against the surface to be tested, and hold the Trigger until the Analyzer shows that the measurement has been completed. When performing readings on flat surfaces, the LPA-1 should be used with the stabilizer mounted

to keep it flat during the measurement. The stabilizer can also be easily removed for making readings on small or recessed surfaces.

After a reading has been completed, the reading number (not the lead concentration) should be entered on the proper location on the worksheet. For example, if the first reading is on center of the baseboard on Wall A, write a number "1" in this location on the worksheet (see Figure). If a reading is taken on unsound paint, the reading number should be circled on the worksheet. The wall and position on the wall (left, center, or right) must be also be checked off when readings are taken on structures like windows or doors.



Repeat this process for all of the surfaces of interest in the first room. Any comments regarding the particular room should be made at the bottom of the worksheet.

Special Circumstances

If the unit is flat against the surface but the display shows the message 'NOT FLAT'

Some rough black or aged dark brown paints can confuse the optical sensors which tell the unit whether it is properly against the surface. In these cases, the insertion of a single piece of paper between the front of the unit and the surface being measured will allow the measurement to be taken in the usual manner. The presence of the paper will not interfere with the accuracy of the measurement.

If there was an operator error during measurement:

It is possible for an operator to make an error during a measurement, such as taking a reading at the wrong spot. In this case, the DELETE button allows an operator to delete the last reading. Press the DELETE button, then the SET button to confirm the deletion. The measurement can then be repeated.

When the TRIGGER is pulled, the Analyzer checks for the presence of a surface, then initiates the reading sequence. The TRIGGER must be continually depressed throughout the reading, otherwise the reading will abort. When the reading is aborted, the Analyzer displays 'ABORT'. Aborted readings are not stored and the Reading Number will not advance. The only exception is the inconclusive signal in Quick Mode (See Section F).

If the LPA-1 displays a warning message

In this case, the user should consult the list of messages given in Section I.

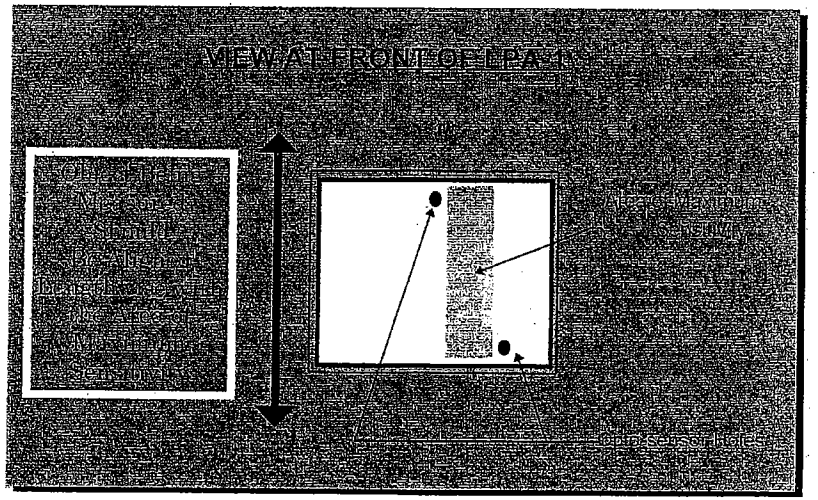
If a reading is required on a recessed surface:

The stabilizer, located on the Analyzer head, is designed to allow for reliable positioning of the Analyzer on large flat surfaces.

To obtain readings in small areas, such as a window well, the stabilizer should be removed. To remove the stabilizer, grasp the LPA-1 Analyzer unit in one hand by the handle, and the stabilizer in the other hand. Slide the stabilizer off the Analyzer in a straight line motion. After obtaining the readings, replace the stabilizer.

If a reading is required on a rough or molded surface:

The performance of the LPA-1 is best on flat surfaces. If the Analyzer head cannot lie flat on a surface, somewhat degraded performance will result. Normally this will result in a lead measurement which is lower than the actual value. The error depends upon the degree of roughness or curvature of the surface. The structure of the reading surface of the LPA-1 is somewhat asymmetric in that the most sensitive reading area is not located in the exact center of the aluminum 'nose.' As shown in the



diagram, the optimal reading area is the vertical area between the holes for the opto-sensors. From the operator's perspective (behind the instrument), the optimal area is about a quarter inch to the left of the arrow on the top of the bezel.

When reading a rounded surface such as a handrail or cove casing, it is best to keep the area of maximum sensitivity aligned lengthwise with the piece being inspected. Also a note should be made on the worksheet and reflected in any report that the reading was made on a curved item and is the best estimate for that surface.

I. DETAILS ON THE BATTERY CHARGER

The battery charger supplied with the LPA-1 Analyzer is a Quick Charge microprocessor based unit capable of recharging the battery pack in under two hours. The charger may be left on with the battery connected indefinitely. *The battery will not overcharge.* If a battery has been only partially discharged or not discharged at all it will be recognized by the battery charger and, after 'topping off' the charge, the charger will stop charging. The charger will display two continuous green lights while a battery is charging. At end of charge, the CHARGE light will flash indicating that it has switched off and the battery is fully charged.

Battery charger error message lights

FAIL LIGHT- This light shows that any number of failures may have occurred. The important point to remember is that most of the failures detected are failures of the battery. The following are quick checks to perform before trying another battery:

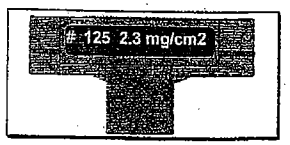
The first check is to verify that the battery is at approximately room temperature. Very cold batteries may temporarily inhibit the charger operation. Either wait a while for the battery to warm or try restarting the charger. The second check is to verify that the charger connector is in proper alignment with the Battery connector. Even though the connector is keyed, it may be possible to jam the connectors together the wrong way. Unplug the battery, and verify the key orientations before plugging the battery in.

HOT LIGHT- The Hot Light indicates that a failure has occurred in the charging circuit resulting in an overheated battery

pack. If the battery is cool and the light is on, the charger cable may be plugged in improperly or the battery may be defective. The Hot Light may also turn on when there is no battery plugged into the charger.

J. LPA-1 MESSAGE DISPLAYS

The LPA-1 provides a number of messages to remind the user of keypad entries, current system conditions, and any conflict that may occur between keypad entries and current conditions. For example, the user may attempt to take a reading with the shutter locked. The following is a complete list and detailed explanation of messages that may appear.



 # XX Y.Y mg/cm2- This is the standard format for any concluded reading, where XX is the reading number and Y.Y is the reading in milligrams per centimeter squared.

 # XXA Y.Y mg/cm2- The 'A' following the reading number indicates that the reading is part of a set to be averaged. The format otherwise is the same as a standard reading.

ABORT- Indicates that the measurement in progress was stopped because the LPA-1 was not sensing a flat surface or because the trigger was released. THAT MEASUREMENT WILL NOT BE SAVED.

AVERAGE- Indicates that the LPA-1 is ready to take a measurement in the AVERAGE MODE. This message replaces the READY message (described below) when the AVERAGE MODE is active. Averaged calculations will appear in two ways. The average will be shown briefly on the display after the last reading in the set. The average calculation will not be saved. When the Inspection Report is created, each measurement will appear separately with the average calculation appearing below the last measurement.

AVERAGE OF X- Indicates that AVERAGE MODE has been turned on and allow the inspector to increment the number of readings in the average set using the SET key. X is the number of reading in the average set.

AVERAGE OFF- Indicates that the AVERAGE MODE has been turned off.

AVERAGE STILL ON- Some operating modes (such as NEW UNIT, and SET) cannot be changed if the AVERAGE MODE is turned on. Turn off AVERAGE to continue.

AVE = XX mg/cm2- After each set of averages the calculated average will be displayed where XX is the average of the set. The average will not be saved, but rather recalculated after down load.

CONFIRM (RESET, DELETE, NEW UNIT SET MODE)- The request to CONFIRM means that the action requested by the user will potentially have serious impact on the data to be included in the Inspection Report. For this reason and to prevent accidental loss of data, it is necessary to press the SET key to complete the action requested. SET is always the key used for confirmation.

DELETE DENIED- Indicates that there has been an attempt to delete the last measurement in a job and either there is no measurement to delete, there has just been a reading deleted, or the last reading taken was a completed set of averages in AVERAGE MODE. Only the last measurement can be deleted from reading memory in the LPA-1.

DELETE AVG SET- Indicates that the DELETE key was pressed while in AVERAGE MODE. Confirmation of delete is required after message.

DISPLAY NORMAL - A mode of operation which will show all information on the display while a reading is being acquired.

JOB SCAN MODE- The JOB SCAN MODE allows the user to review on the screen all the measurements taken in the current job. The measurements may only be viewed, they may not be changed or deleted.

LOW BATTERY- Indicates that the battery must be charged. No measurements may be taken.

MEMORY LOW- Indicates that the memory is nearly full. Less than 90 more readings can be stored from the point at which MEMORY LOW first appeared. Measurements taken during MEMORY LOW are displayed and *will be saved*, but the reading data in the LPA-1 must be downloaded to a computer and RESET (see RESET key) to store more than ninety measurements

MEMORY FULL- Indicates that the LPA-1 memory is full. Any measurements taken while MEMORY FULL is being displayed *will not be saved* however, the measurements are displayed for manual recording if the user so desires. The LPA-1 must be downloaded to a PC and RESET (see RESET key) to clear the memory for new measurements.

MUST CHANGE UNIT- A warning to the inspector that the number of readings in the current job is greater than 990. After 999th reading the LPA-1 will prevent any more measurements in that job. To continue on start a new unit.

NO READINGS- Indicates that there are no measurements in the current job. Consequently, there is no measurement to recall or delete.

NOT FLAT- Indicates that the flatness sensors in the front of the LPA-1 (which look for a surface through the two small holes in the nose) are not on a flat surface. For safety, the LPA-1 will not allow the source to be exposed unless the nose is flat on a surface.

Q-MODE Y OF Z- Indicates that the LPA-1 is acquiring a reading in AVERAGE MODE. Y is the current reading number in the average set, and Z is the total number of readings in the set.

READY- Indicates that the LPA-1 is ready to take a measurement. When the LPA-1 is first turned on, a number of internal tests are performed automatically. These tests take only a few thousandths of a second and cannot be noticed by the user. READY indicates that these tests have been completed and the instrument is ready to take a lead measurement.

READING- The instrument is acquiring a reading in QUICK MODE. Starting at 4 seconds the instrument will show interim readings, updating every 4 seconds.

SCREEN SAVER - A mode of operation which will turn off the display while a reading is being acquired to conserve battery life.

XX SEC Y OF Z- Indicates that the LPA-1 is acquiring a reading in AVERAGE MODE. XX is the length of the reading, Y is the current reading number in the average set, and Z is the total number of readings in the set.

XX SEC Y.Y mg/cm2- Interim readings in QUICK MODE appear every 4 second to alert the operator to the status of the measurement. *Do not confuse an Interim reading with a reading that has concluded as either positive, negative, or inconclusive.* XX indicates the elapsed time, and Y.Y is the interim reading.

XX SECOND READING- Indicates the LPA-1 is acquiring a reading in STANDARD MODE (not being averaged). XX is the length of reading.

SHUTTER STUCK- Indicates that the system's source shutter sensor has detected a possible malfunction and the shutter may still be open. This can be a serious malfunction and should not occur. However, should it ever occur KEEP THE INSTRUMENT POINTED AWAY FROM YOURSELF AND OTHERS, slip off the stabilizer and turn the manual LOCKING LEVER located under the front nose section to the LOCKED position. This will mechanically force the shutter to close. The instrument should then be sent to RMD for repair.

SHUTTER LOCKED- Indicates that the Manual Shutter Lock is in the locked position. Turn the lever to the unlocked position to take a measurement.

START NEW UNIT- This message indicates that the LPA-1 has been reset to JOB #0 with the RESET key. Whenever JOB #1 is created using the NEW UNIT key, that time is saved and will appear as the Job Start Time on the Inspection Report. Therefore, JOB #0 is a dummy job created to allow the starting time of a new job to be recorded at other than the time of RESET.

This message can also indicate 999 measurements have been entered into the current job, a **New Unit** must be created to continue.

TEMPERATURE- Indicates that the temperature of the LPA-1 electronics exceeds the operating range of the instrument.

UNIT 0- This display is a 'dummy' job indication that always appears before the first job is created. The starting time of each

job that appears on the Inspection Report created by the Automatic Report Generator is the time at which the NEW UNIT key is used. For this reason, after a memory reset has been performed using the RESET key, the first unit (UNIT ONE) is not created until the user wants to record the starting time of a job.

Part III

Appendices

Appendix A INSPECTION STRATEGIES

The keys to productivity in the field lies largely in the principles of time and motion and in a thorough understanding of the tools at hand. If the same work can be performed with less motion, the work will be completed faster and with better quality. In the case of the Lead Paint Inspector, the tools are the XRF analyzer and report generation system.

Establish a Protocol That Works For You

The actual techniques employed will depend on the style and preference of the individual inspector as well as the kind of inspection job at hand, but by adopting a **consistent pattern** in the way which readings are taken and worksheets filled out for various types of residential and commercial jobs, the speed of inspections can be increased.

One procedure might be to inspect all the walls in a room in one pass then inspect the windows, doors and other structures in a second pass. This approach eliminates the need to turn the worksheet over more than once to switch between the drawing of the room and the drawings of the other structures.

Beginning a New Room in the Same Unit

To begin a new room in the same unit, the inspector may use a new worksheet or might double up rooms on one sheet by denoting in some way which readings belong to the second room. One convenient way to do this is to code the reading numbers as they are recorded by adding a letter to the reading number. In this case readings in room #1 could be recorded as A1, A2, A3, etc. and readings from room #2 might be saved as B23, B24, B25 and so on. The cost per sheet is only about 3 cents, but the efficiency of

reduced paper handling may make a coding scheme a good idea for some jobs. When a new worksheet is started, be sure to enter the Unit Number and the Job Number at the top. Worksheets can be inserted into the compartment of the clipboard for storage.

Make the Job Easier for the Person Creating the Inspection Report

If readings are taken in a consistent sequence on every job no time is wasted hunting around the worksheets when it's time to create the Inspection Report.

It is also helpful is to enter the number of the first and last readings at the top of each worksheet. These entries make it much easier for the person doing the data entry to know when they have completed all of the readings on a particular sheet.

Appendix B RECORD KEEPING

The Radiation Safety Officer (RSO) must maintain all documents and records relating to the instrument, including but not limited to:

1) *Company License, Device Registration and Administrative Records*
   - Company personnel licenses.
   - Device registration(s) for instruments in possession.
   - Training Certification (certificates) for all operators of the instrument(s).
   - Reciprocity licenses, letters of notification (if applicable) from other states where device is transported or used.
   - Official correspondence from the state (inspection reports).
   - State Regulations concerning radiation safety for the device.

2) *Shipping and Receiving Records*
   - Copy of shipping documents (inbound and outbound).
   - Copy of license of any persons the device is transferred to outside of company.

3) *Storage and Maintenance Records*
   - Leak or swipe test reports (every 6 months) (Form I).
   - Physical inventory records (every week).
   - Dosimetry reports.
   - Instrument accountability records (Form A).

Appendix C EMERGENCIES - ACCIDENTS OR THEFT

The LPA-1 Analyzer contains a radioactive material. This section contains specific procedures to be followed in the case of an accident or emergency. If an LPA-1 is damaged due to shipment or an accident such that its radiation safety integrity is suspect, contact a service representative and RMD Inc. immediately. If any hardware items are damaged, even if the system remains operational, contact a service representative.

Introduction

The safety of the operator, bystanders, and emergency service personnel should be of the highest priority in an event of accident. The source material used in the LPA-1 is encapsulated in tungsten, which is securely and permanently mounted within each device. It is highly unlikely that this radioactive material could become loose in the event of an accident, but emergency procedures must be strictly followed in case this unlikely event has occurred.

Accident

1) The first action must be to keep other people away from the site.

2) If the Analyzer is only superficially damaged and the device is in one piece with only a minor break or two in the housing, and the source is obviously in place,
   - Inspect the Analyzer head visually, from a distance, to determine any damage to the Analyzer head. Use a radiation survey meter if one is available.

- If the source is intact, pick up the Analyzer, place it in its storage container, and return it to the permanent storage area.
- Call RMD Technical Assistance to ship the Analyzer back to the factory for repair.

3) If the Analyzer is broken, severely damaged with parts strewn around, severely burned, or the source holder is clearly damaged,
   - Rope off the damage site for 10 feet around the Analyzer. Do not walk through the damage site, since radioactive material can be tracked elsewhere.
   - Call the RMD Radiation Safety Officer and the nearest public health department for help. Get an expert radiation technician to the site with a survey meter to determine if the radioactive material is lost or intact.
   - The radiation expert will determine whether the site is safe, will remove the contamination if there is any, and will prepare the device for shipment to the factory for repair.
   - Call RMD Technical Assistance to ship the Analyzer back to the factory for repair.

Loss or Theft

1) Notify the state public health department, the local police, and the RMD Radiation Safety Officer immediately in the case of theft.
2) Take the following precautions to avoid loss or theft:

- Always keep the device in locked storage when not in use.
- When in the field, lock the device in a vehicle (preferably the trunk) or in a field office.
- When in the field, do not leave the device unattended.
- Do not allow unauthorized use of the device by someone who has not received proper training by RMD.
- Do not lend the device to someone

Appendix D HOW TO GET AN OPERATOR'S LICENSE

The LPA-1 system contains an accelerator produced, radioactive material. In order to own, handle, possess and operate an equipment containing radioactive material of this type, a license or registration from the state regulatory agency must be obtained. Such a license is required before RMD, Inc. can ship an LPA-1 Lead Paint Analysis system.

LPA-1 instruments utilize a sealed radioactive isotopes (Co^{57}) to excite lead atoms in the paint. The isotope is installed and shielded from the operator in such a way that actual radiation exposure is well below the maximum permissible dose allowed when handled properly and in accordance with the safety precautions recommended by RMD, Inc.

To find out the requirements in your area contact your State regulatory agency. The name, address, and telephone number of the regulatory agency in each state is provided in Appendix K.

Contact the local State authority and advise them of your need to acquire "A license or registration to possess XRF equipment containing Cobalt 57 (Co^{57}) radioactive material." Also obtain a copy of the State's regulation concerning radiation safety and record keeping procedures.

Most states will require the applicant to submit:

1. A license application, including the name and address of the applicants business, type of business activities, resumes of owners, and experience and training with hazardous materials.
2. A drawing and relevant details of where the device is to be stored.

3. The device registration (from RMD, Inc.).
4. A formal Radiation Safety Program.
5. Evidence of training and relevant education.

The LPA-1 system has been reviewed under the CRCPD device registration by the Colorado State Department of Health. A copy of the device registration is available upon request.

The copy of the state regulations will provide the proper procedures for use, reporting, and disposal of a device containing radioactive material. Please follow these regulations accordingly.

To obtain a registration, license, or amend an already existing license, specific training is required and must be provided by RMD, Inc. A certificate of training is issued by RMD after completion of its training program.

We will be glad to assist you with completion of any application for obtaining a State license. Contact RMD for any questions you may have regarding radiation safety, licensing procedures or training.

RMD, Inc. provides one day Operator Training Seminars on a regular basis at various locations around the country. Contact us for the latest schedule.

Licensee's Requirements

The possession, use, and transfer of accelerator produced radioactive materials is regulated by each State's regulatory agency. The possession and use of these materials do not fall under the NRC jurisdiction as yet.

As a recipient of a radioactive material containing device the user has certain responsibilities and must follow certain procedures for radiation safety and record keeping.

Some of the user responsibilities are briefly listed below.

- The owner must always know where the Instrument is.
- The owner must follow the manufacturer's operating procedures.
- The owner and other users of the device must receive manufacturer's training for operation of the device.
- The owner must assure that the labels on the device are left in legible condition and are not removed.
- The owner must follow all instructions on labels provided with the device.
- The owner must obtain a copy of the appropriate State radiation regulations and study them.
- The owner must test for source leakage each 6 months and keep records of the results of such tests for a specified period.
- The owner must store the device in a safe place where it is unlikely to be stolen or removed accidentally.
- The owner must maintain records of the storage, removal, and shipment of the device.
- The owner must monitor the operator's compliance with safe use practices. Use dosimetry devices.
- The owner must have a radiation safety program and implement and document radiation safety procedures.

- The owner must report sale or transfer of this device to RMD and the owner's state regulatory agency. The transferee must have a license.
- The owner must leave the radioactive material in the device undisturbed and make no attempt to open the device for repair.
- The owner must report to RMD and the Regulatory Agency any damage to the radioactive source or source shielding, any leak test result indicating a leaking source, and any loss or theft of the device.
- The owner must not loan or rent the devise to an unauthorized person untrained by RMD

State License, Application Information

Applications for license and registration of an XRF device containing an accelerator produced radioactive source requires the general information listed below. If there are any questions that are not addressed here please contact us for specific information.

Device Information:

Name: LPA-1 Lead Paint Analysis System.

Manufacturer: RMD, Inc, 44 Hunt St., Watertown, MA 02172, 617-926-1167.

Usage: Portable XRF application for measurement of lead in paint

Calibration required: None.

Source Information:

Radioactive material: Cobalt-57 (Co^{57}).

Maximum Activity: 12 millicurie (12 mCi).

Chemical or Physical Form: Sealed source, special form N.O.S.

Usage: The sealed source is contained in an XRF system for analytical measurement of lead in paint.

Leak Testing Frequency: Every six months.

Type of Leak Test: Wipe test provided by a commercial leak test company.

Disposal: Return to manufacturer for disposal.

Facility and Radiation Safety Program:

Operator Names and Training: List the name of the employees who will use the device. Provide each individual's training, experience, and training duration in appropriate spaces.

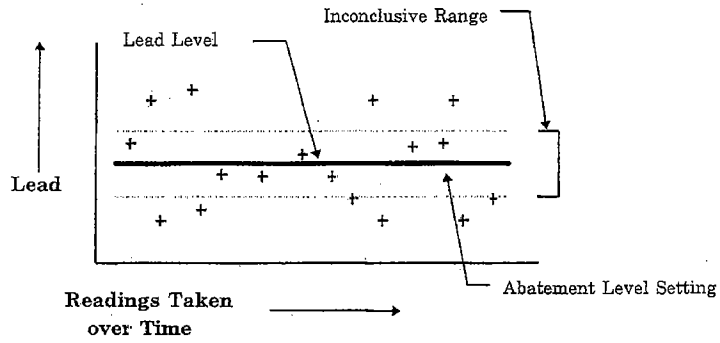
Facilities and Equipment: Provide a description of the owner's facility, where the device will be stored and the list of radiation measuring equipment at the facility.

Radiation Safety Officer: Assign a responsible person with sufficient training in radiation safety as the Radiation Safety Officer (RSO). Provide the name and training in appropriate space.

For any additional information and help with the application contact RMD, Inc.

Appendix E AVERAGING READINGS IN QUICK MODE

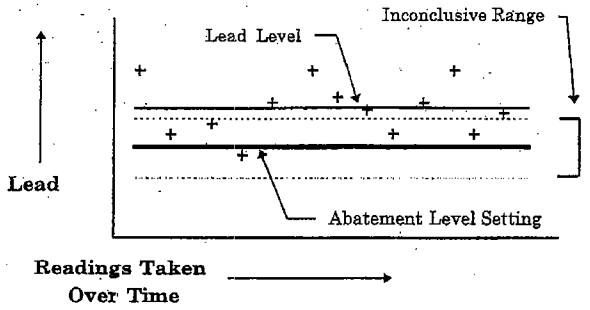
If the user wishes to measure lead content with the highest possible accuracy rather than determining whether a surface is lead positive or negative with the highest possible speed, Standard Mode should be used. This is because the mechanics of Quick Mode involve sophisticated statistics that can affect the average of a series of readings. The following are two examples of readings taken in Quick Mode with the resulting implications for the reading averages.



+ = Typical result of reading after two seconds

In the case above, the Abatement Level is set at the same value as the lead on the surface being measured. If a series of readings are taken in Quick Mode under these conditions, the readings will normally (95% of the time) run out for the maximum amount of time and be displayed as the abatement level. A fraction of the readings, being outside of the inconclusive range, will

conclude early and produce a positive or negative result. If enough readings are taken, it will be found that an equal number of readings will be above and below the inconclusive range, and the average of all readings will be equal to the lead level. The mean of the readings will therefore have no bias.



For the second case, assume that the Abatement Level is set below the actual lead level of the surface being measured. For a series of readings taken under this condition, some of the readings will be above the inconclusive range after two seconds and some will be within. No readings will be below. The readings that are above the inconclusive range will end and be displayed. The readings that are within the inconclusive range at two seconds will continue for a longer period of time during which the precision will improve. At some point these readings will also conclude, but there will be no readings concluding within or below the inconclusive range because

1. The lower part of the statistical spread within the inconclusive range will run out until either 60 seconds have passed, or the reading precision causes the reading to move above the inconclusive range at which point the reading will be displayed.
2. The spread of the readings at any point in time never includes values below the inconclusive range.

As a result, the mix of readings will be weighted toward the high values. In the case where the actual lead value is below the Abatement Level, the average of the readings will be skewed in the opposite direction, because the inconclusive range in this case would consume the upper half of the readings.

Appendix F TRANSPORTING THE LPA-1

Local Transportation

Each LPA-1 is supplied in a case with a lock. Keep the case locked when transporting the device.

When transported in a passenger vehicle, keep the shipping container with the LPA-1 in the trunk. When a station wagon or panel truck is used, secure the LPA-1 case so that it cannot slide around. When carried in a six-passenger pickup with a service body, transport the LPA-1 in the back with the storage lid locked. When a pickup is used, the box containing the device must be secured to the bed of the vehicle to prevent movement and in such a way to prevent removal by a passerby

Transportation by Air

Although the LPA-1 contains a radioactive source, the Analyzer System together with its carrying case have been designed so that under present regulations, it can be easily shipped by air. However, shipment of any radioactive sources must be done very carefully to avoid any violation of state or federal regulations.

The shipment of devices containing radioactivity is regulated by the Department of Transportation (DOT) as is outlined in the Code of Federal Regulations 49 CFR. In addition to these regulations, a package intended for air transport must also meet the "Dangerous Goods Regulations" of IATA. We highly recommend the user obtain a copy of both regulations from the Government Printing Office in the owner's area.

In general, the transportation requirements such as packing, labeling, and paper work for radioactive materials vary with the type, activity, and shielding of the particular radionuclide involved.

These requirements are explained in 49 CFR and IATA packing instructions for class 7 radioactive materials regulations. For the LPA-1 Analyzer System, the detailed procedure is presented below.

The LPA-1 system incorporates a Co^{57} radioactive material. The LPA-1 is shipped from the factory in a special storage case bearing a radioactive material label. This case is then further enclosed in a strong cardboard shipping box which is of a particular size to comply with certain of the regulations. *For this reason, it is best to save the shipping box.*

As sent from the factory, the LPA-1 Analyzer System is packaged so that the radiation level at the surface of the shipping package is below 0.5 mRem/hr. A shipping container with the above characteristics falls under "Excepted Radioactive Material, Limited Quantity, N.O.S., UN2910, Instruments and Articles" category. If the proper procedures are followed, this category of packages does not require characterization, labeling and shipment declaration of dangerous goods. To ship an LPA-1 to RMD, Inc., it is best to use a service such as Federal Express and follow the directions below.

1. Make sure the radioactive material labels on the device and its carrying case are intact and clearly visible upon opening the package.
2. Place the case in the shipping box that was sent to the user by RMD, Inc. with sufficient packing material to secure the case inside.
3. Seal the box and all corners with shipping tape.
4. In the Air Waybill describe the consignment as "Excepted Radioactive Material - Instruments and Articles".

5. Put the 24 hour emergency response number on the owner's shipping document.

6. Place a notice with the package or with the packing list with the **sender's name** on top and the following statements;

This package conforms to the conditions and limitations specified in 49 CFR 173 421 for Excepted Radioactive Material, Limited Quantities, N.O.S., UN2910 and also IATA Section 6.2.1.4.

This is to certify that this package conforms to all packing requirements of the US Department of Transportation and the International Air Transport Association rules and regulations regarding the shipment of Radioactive Materials, Limited Quantities.

The radiation level on the surface of this package is less than 0 5 mRem/hr.

No other labels required.

Appendix G WARRANTY, MAINTENANCE AND TROUBLESHOOTING

DISASSEMBLY OF ANY COMPONENTS, EXCEPT TO REPLACE THE BATTERIES, WILL VOID THE USER WARRANTY AND MAY LEAD TO UNNECESSARY RADIATION EXPOSURE.

Limited Warranty

The performance of the instrument is warranted for the life of the instrument to the original owner. Material defects and workmanship are warranted for two years to the original owner. For full details, see the warranty sheet packed with the LPA-1.

Used Instrument Warranty

In the event that an LPA-1 has been purchased used, RMD will, for a nominal fee, provide user training, upgrade the software and instrument to the latest revisions, and warranty the instrument to the new owner. Contact the factory for more information.

Instrument Maintenance

The LPA-1 is generally a maintenance free instrument. However, there are a few procedures that may optimize system performance. To remove any accumulation of lead that may become deposited on the reading area of the aluminum plate on the nose of the LPA-1, it is recommended to periodically wipe the area off with a paper towel lightly moistened with glass cleaner.

Rarely, the instrument may pick up a piece of debris that clogs one of the holes for the infrared surface sensor at the reading surface. The display will show NOT FLAT under this circumstance. This is usually the result of dragging the LPA-1

along a painted surface which is not recommended. If a problem does occur, clean out the optical sensor holes by removing the debris with a toothpick or other **non-metallic** pick or blow out the hole with compressed air under moderate (<60 PSI) pressure.

To maximize battery life, it is recommended that both batteries be used on an alternating basis and, if practical, a battery should be receive several hours of usage before charging. Unused Batteries in storage should be recharged every sixty days or so.

Source Replacement

The CO^{57} radiation source used in the LPA-1 has a half life of 9 months. However because of the fast initial speed of the system and other design features, it is generally recommended that for high volume users, the source be replaced only after 12 to 15 months. Other users may find that performance is acceptable for an even longer period of time.

Field Service And Trouble Shooting

RMD technical staff are available to answer any questions relating to the operation of the LPA-1 system. Field service hours are 8:30 AM to 5:00 PM EST. To reach us, call 1-800-LEAD-RMD. Before calling, a quick check of a few items can often save time.

For problems related to the instrument:

- Make sure the key lock is unlocked
- Make sure the batteries are fully charged
- Make sure the manual shutter lock lever is turned off (pointing straight back at the trigger)

For problems related to the software:

- Make sure the cable from the LPA-1 to the computer is attached properly and securely.
- Make sure the hardware is configured properly through the COM port.
- Make sure the printer is properly attached and the correct drivers are loaded.

When calling RMD for help please have the following information available:

- The name of your company and the serial number of the unit. The serial number can be found on the underside of the unit.
- As much detail about the problem as possible. Information such as length of reading, reading mode, and error messages encountered are extremely helpful. For report generation problems know the revision level, and your PC and printer brand names.
- Have ready an understanding of the circumstances surrounding the problem; what were the surfaces being shot, exterior or interior, how often does the problem occur and can it readily be repeated.

APPENDIX H TESTING BACKGROUND & HISTORY

Lead Paint Testing

Environmental Lead Contamination

Lead is a heavy, soft, malleable, bluish metal with many uses, but it is also a highly toxic and cumulative poison. Lead has been recognized as an industrial hazard for many years but only recently has its long-term effects as an environmental hazard been known.

The versatility of lead, as well as its favorable physical and chemical properties, have accounted for its extensive use for centuries. Its industrial uses include the production of electrical batteries, ammunition, various chemicals, additives for gasoline and additives for paint. It has also been used in building construction in roofing, cornices, electrical conduits, water pipes and sewer pipes. Lead compounds such as white lead and lead chromate have been widely used as pigments in paints. Lead is also commonly present in varnishes and primers. Although the use of lead-based paint has declined over the years, especially on interior surfaces, most housing units built before 1978 contain some lead-based paint.

Experts agree that there are three major sources of lead exposure today: (1) lead-based paint; (2) urban soil and dust; and (3) drinking water, primarily from dissolved leaded solder contained in service lines. These sources are considered major because of the large number of people who are exposed. Other sources can result in high exposure in individual cases.

An individual can become poisoned by lead through exposure to a single high level source or through the cumulative effect of repeated exposures to several low level sources. High level

exposures can occur through deteriorating paint in a house. High level or acute lead exposure can be severe and can result in convulsions, coma, and even death.

Lead in Paint

The amount of lead-based paint in housing is significant: tens of millions of housing units contain at least some lead-based paint. Children living in homes with lead-based paint can become exposed to that lead by eating chips of lead-based paint or by chewing on protruding surface painted with lead-based paint. The most common route of exposure, however, is the ingestion of lead-bearing dust that is generated by the paint when it deteriorates, chalks, or is disturbed through renovation or even abrasion from the opening and closing of windows. Even in these indirect ways, lead-based paint can be a source of severe lead poisoning.

HUD estimates that 57 million housing units built prior to 1978 have lead based paint on the exterior of the building, the interior, or both. At least 20 million units represent excessive levels of lead dust or unsound paint. These units are immediately risk environments.

The amount of lead which is on a wall depends on several factors, including the concentration of lead in the paint and the number of layers of paint and their thickness. The concentration of lead on a painted surface is generally measured in milligrams per square centimeter (mg/cm^2), which is the weight of lead over the total depth of paint on a 1 cm x 1 cm area of the surface.

Health Effects

The severity of the lead contamination problem is only now being fully realized. Children are especially vulnerable to lead poisoning. Lead in the body can cause serious damage to the central and peripheral nervous system, the cardiovascular system,

and the kidneys. Exposure to high concentrations of lead can cause retardation, convulsions, coma, and death. Even low concentrations of lead persisting during childhood are known to slow a child's normal development and cause learning and behavioral problems. The Agency for Toxic Substances and Disease Registry reports long-lasting impacts on intelligence, motor control, hearing, and emotional development of children who have levels of lead in the body not associated with obvious symptoms.

Lead serves no useful purpose in the body. It is a poison which binds with the chemicals that aid biological reactions throughout the body.

Exposure to lead is generally characterized by the concentration of lead in whole blood, usually expressed in micrograms of lead per deciliter of blood (μg/dl). It indicates the amount of lead circulating in the bloodstream, a measure of recent exposure to lead. In October, 1991, the Centers for Disease Control set 10 μg/dl as the blood lead level requiring medical intervention. They recommend community prevention activities if many children in the community have blood lead levels exceeding 10 μg/dl. Medical evaluation and environmental investigation and remediation should be implemented for all children with blood lead levels exceeding 20 μg/dl. All children with blood lead levels exceeding 15 μg/dl should have nutritional and educational intervention and more frequent screening. The fatal dose to children is 100-150 μg/dl. Note that the natural background level of lead in pre-industrial times was ~0.1 μg/dl. Under no circumstances should 10 μg/dl be regarded as a harmless level of blood lead.

The first step in the treatment of suspected lead poisoning is to remove the patient from further exposure. A second step is chelation therapy, in which medicines (chelators) remove lead from the body. Chelators bind irreversibly to the lead in the bloodstream so it is excreted through the urinary system. Since it may cause serious side effects, chelation is used only in cases of high levels of blood lead under the care of a medical specialist.

Regulatory Background

Over the last two decades the Federal government has taken a number of key actions to reduce the risks of lead exposure. It has banned the use of lead in house paints and in the solder and pipes used in public drinking water systems. It has encouraged the phase-out of solder in food cans. The EPA has contributed to these efforts by taking action to virtually eliminate lead from gasoline and by developing new standards for drinking water.

These actions have been very effective in reducing major sources of lead exposure. Deaths from lead poisoning, which up to 20 years ago were not uncommon, have been almost eliminated. However, old lead-based paint and the associated contaminated dust and soil remain largely untouched as environmental sources of lead. Moreover, continuing scientific research has demonstrated that harmful effects may occur at lead levels previously considered safe. Experts agree that a large number of children are still at unacceptable levels of risk.

Although the risks of exposure to lead have been known for centuries, it was not until the 1950's that public health officials in some of the larger US cities began to trace the cause of many health problems to lead-based paint. In the 1950's and 1960's, several older, larger cities began to regulate the use of lead-based paint and to screen children for lead poisoning. In 1955 the paint industry adopted a voluntary standard limiting the use of lead in interior paints to no more than 1% by weight of nonvolatile solids. In 1971 the Federal Government enacted the Lead-Based Paint

Poisoning Prevention Act (LBPPPA) which, among other things, prohibited lead-based paint in residential structures constructed or rehabilitated with Federal assistance. Lead-based paint was defined to be paint containing more than 1% lead by weight.

In 1973 the LBPPPA was amended to lower the lead content allowed in paint to 0.5%, while in 1977, it was amended to lower the content to 0.06%. In 1978 the Consumer Product Safety Commission banned the sale of lead-based paint to consumers and the use of lead-based paint in residences and areas where consumers have direct access to painted surfaces.

In 1987 Congress amended the LBPPPA to require the Department of Housing and Urban Development (HUD) to (1) define intact lead-based paint surfaces as an "immediate hazard" requiring treatment, (2) conduct inspections of a random sample of dwellings in pre-1978 housing developments and to abate lead hazards exceeding 1.0 mg/cm^2, and (3) conduct an extensive research and development program. Further amendments required a comprehensive and workable plan for abatement in public housing. Recently, a number of Federal agencies, including the HUD, EPA, and HHS have formed a task force to ensure that the regulatory efforts conducted under different statutory authorities produce a unified and coherent approach to lead pollution problems.

State and local regulations also exist in many areas. Inspectors must determine whether or not state and local regulations conflict with the Federal regulations. If they do, the most stringent requirements, from each of the regulations, must be complied with. For example, the State of Maryland requires the abatement of lead-based paint if the concentration, as measured by a portable X-Ray Fluorescence Detector, exceeds 0.7 mg/cm^2. This is lower than the HUD standard of 1.0 mg/cm^2. In this case, the inspector would follow the Maryland standard since it is more

stringent. If however, another state requires abatement only if the concentration exceeds 1.2 mg/cm^2, an inspector engaged in public housing inspections would follow the HUD Interim Guidelines, since they are more stringent.

Appendix I REFERENCES AND RELATED LITERATURE

References and Related Literature

NBS Handbook 93, Safety Standard For Non-Medical X-Ray And Sealed Gamma-Ray Sources.

Principles and Practices of X-ray Spectrometric Analysis, E P Bertin, Plenum Press, New York, NY 10011.

Code of Federal regulations, 10 CFR, 29 CFR, and 49 CFR

Model Lead Inspector Training Course, EPA Contract No 68-D0-0099, David Cox & Associates.

Appendix J PARTIAL LIST OF RADIATION SAFETY DEVICES AND SERVICES

The following is a list of companies that supply radiation related instrumentation and services.

Radiation Detection Instruments, Survey Meters

A low energy gamma radiation detection instrument (survey meter) is ideal for this application. This device must have a good sensitivity up to 100 keV gamma-ray energy and range of 0-200 mRem/hr. Following is the partial list of providers of such instruments:

Atlantic Nuclear Corp., 617-828-1319.

Dosimeter Corp., 513-244-1241

Eberline Instrument Corp., 505-471-3232.

Ludlum Measurements, Inc , 915-235-5494.

Nuclear Associates, 516-741-6360.

Technical Associates, 818-883-7043.

Victoreen Inc., 216-248-9300.

Film Badge Services:

Eberline Analytical Corp., (TL), 505-471-3232.

ICN Dosimetry Services, (FB, TL), 714-545-0100.

Landauer Inc.,(FB, HF, TL, WB), 708-755-7000.

Siemens Gammasonics Inc., (FB, TL), 800-666-4552.

Leak Test Kit Providers

Siemens Gammasonics Inc., 800-666-4552.

Appendix K LIST OF THE STATE REGULATORY AGENCIES

Manager
Radiological Health Program
Dept. of Health & Social Services
320 W. Willoughby, Suite 101
P.O. Box 110613 Tel: (907) 789-9858
Juneau, AK 99811-0631 Fax:

Mr. David K. Walter
Director
Division of Radiation Control
State Department of Public Health
State Office Building Tel: (205) 613-5391
Montgomery, AL 36130-1701 Fax: 205 242-5315 24hr

Ms. Greta J. Dicus
Director
Division of Radiation Control
Department of Health
4815 W. Markham Street, Slot 30 Tel: (501) 661-2301
Little Rock, AR 72205-3867 Fax:

Mr. William A. Wright
Program Manager
Arizona Radiation Regulatory Agency
4814 South 40th Street Tel: (602) 255-4845
Phoenix, AZ 85040 Fax: 602 223-2212 24/hr

Mr. Gerald Wong, Health Physicist
Radiologic Health Branch
Environmental Health Division
State Department of Health Services
714/744 P Street, P.O. Box 942732 Tel: (916) 323-2759
Sacremento, CA 94234-7320 Fax: 916 391-7716 24 hr

Mr. Martin L. Hanrahan
Radiation Control Division
Department of Health
4300 Cherry Creek Drive South Tel: (303) 692-3056
Denver, CO 80222-1530 Fax:

Mr. Kevin T. A. McCarthy
Director
Radiation Control Division
Dept. of Environmental Protection
165 Capitol Avenue Tel: (860) 424-3029
Hartford, CT 06106 Fax: (860) 566-3333 24hr

Mr. James R. Murphy, Administrator
Dept. of Consumer & Regulatory Affair
Service Facility Regulation Admin.
614 H Street, N.W., Room 1014 Tel: (202) 727-7190
Washington, DC 20001 Fax: (202) 727-7780

Mr. Allen C. Tapert
Program Administrator
Office of Radiation Control
Division of Public Health
Federal & Water Streets, P.O. Box 637 Tel: (302) 739-3787
Dover, DE 19903 Fax: 302 678-9111 24 hr

Mr. William Passetti, Manager
Chief
Office of Radiation Control
Department of Health & Rehabilitaion
1317 Winewood Boulevard Tel: (904) 487-2437
Tallahassee, FL 32399-0700 Fax: 407 297-2095 24 hr

Mr. Thomas Hill, Manager
Radioactive Materials Program
Department of Natural Resources
4244 International Parkway, Suite 114 Tel: (404) 362-2675
Atlanta, GA 30354 Fax: 800 241-4113 24 hr

Mr. Russell S. Takata, Chief
Noise & Radiation Branch
Environmental Health Services Div.
Department of Health
591 Ala Moana Boulevard Tel: (808) 586-4700
Honolulu, HI 96813-2498 Fax:

Mr. Donald A. Flater, Chief
Bureau of Environmental Health
Iowa Department of Public Health
Lucas State Office Building Tel: (515) 281-3478
Des Moines, IA 50319 Fax: (515) 242-6284

Mr. Joseph Klinger, Head of Licensing
Office of Radiation Saftey
Department of Nuclear Safety
1035 Outer Park Drive Tel: (217) 785-9948
Springfield, IL 62704 Fax: (217) 782-9762

Mr. David Nauth, Chief
Radiological Health Section
State Board of Health
1330 West Michigan Street
P O. Box 1964 Tel: (317) 383-6152
Indianapolis, IN 46206 Fax: (317) 633-0776

Mr. Gerald W. Allen, Chief
X-Ray & RAM Control Section
Department of Health & Environment
Bureau of Air & Radiation
109 S.W. 9th Street Tel: (913) 296-3176
Topeka, KS 66612 Fax: (913) 296-0984

Vickie D. Jess
Supervisor
Radiation Control Branch
275 East Main Street Tel: (502) 564-3700
Frankfort, KY 40621-001 Fax: (503) 564-6533

James Sanford, Ph.D.
Program Manager
Radiation Protection Division
Office of Air Quality & Radiation Pr
7290 Bluebonnet Road, P.O. Box 82135 Tel: (504) 765-0143
Baton Rouge, LA 70884-2135 Fax: (504) 765-0222

Mr. Robert M. Hallisey, Director
Radiation Control Program
Department of Public Health
305 South Street, 7th Floor Tel: (617) 727-6214
Jamaica Plain, MA 02130 Fax: (617) 727-2098

Mr. Charles R. Flynn
Radiological Health Program
Air & Radiation Management Administr
Maryland Dept. of the Environment
2500 Broening Highway Tel: (410) 631-3300
Baltimore, MD 21224 Fax: (410) 631-3198

Mr. Jay Hyland, Radiation Specialist
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State House, Station 10 Tel: (207) 287-5676
Augusta, ME 04333 Fax: (207) 287-4172

Mr. David W. Minnaar, Chief
Division of Radiological Health
Department of Public Health
3423 North Logan Street
P.O. Box 30195 Tel: (517) 335-8200
Lansing, MI 48909 Fax: (517) 335-9526

Ms. Judith Ball, Acting Manager
Section of Radiation Control
Department of Health
925 Delaware Street S.E.
P.O. Box 59040 Tel: (612) 627-5039
Minneapolis, MN 55459-0040 Fax: 612 649\5451

Mr. Mike Tachdear
Bureau of Radiological Health
1730 East Elm Street
P.O. Box 570 Tel: (314) 751-6160
Jefferson City, MO 65102 Fax: (314) 751-6010

Mr. Eddie S. Fuente, Director
Division of Radiological Health
State Department of Health
3150 Lawson Street
P.O. Box 1700 Tel: (601) 354-6657
Jackson, MS 39215-1700 Fax: (601) 354-6167

Mr. Adrian C. Howe
Bureau Chief
Occupational & Radiological Health
Dept. of Health & Enviro. Sciences
Cogswell Building, Room A-104 Tel: (406) 444-3671
Helena, MT 59620 Fax: (406) 444-1374

Mr. J. Robin Haden, Chief
Division of Radiation Protection
Dept. of Enviro., Health, & Nat. Res.
3825 Barrett Drive
P.O. Box 27687 Tel: (919) 571-4141
Raleigh, NC 27611-7687 Fax: (919) 571-4148

Ms. Dana K. Mount, Director
Division of Environmental Engineering
Department of Health
1200 Missouri Avenue, Room 304
P O. Box 5520 Tel: (701) 221-5188
Bismark, ND 58502-5520 Fax: (701) 221-5200

Ms. Julie Peterson, Health Physicist
Division of Radiological Health
Department of Health
301 Centennial Mall, South
P.O. Box 95007 Tel: (402) 471-2168
Lincoln, NE 68509 Fax: (402) 471-0169

Mr. Dennis P. O'Dowd, Supervisor
Radiological Health Bureau
Division of Public Health Services
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6 Hazen Drive Tel: (603) 271-4585
Concord, NH 03301-6527 Fax: (603) 225-2325

Mr. John Feeney
Radiation Protection
Division of Environmental Quality
Dept. of Enviro. Protection & Energy
CN 415 Tel: (609) 987-2132
Trenton, NJ 08625-0415 Fax: (609) 987-6390

Mr. Beneto Garcia, Chief
Radiation Program
Department of the Environment
525 Camino de los Marquez
P.O. Box 26110 Tel: (505) 827-4358
Sante Fe, NM 87502 Fax: (505) 827-4361

Mr. Stanley R. Marshall, Supervisor
Radiological Health Section
Health Division
Department of Human Resourses
505 East King Street Tel: (702) 687-5394
Carson City, NV 89710 Fax: (702) 687-5751

Rita Aldrich, Director
Bureau of Environmental
Radiation Protection
New York State Health Department
Two University Place Tel: (518) 457-1202
Albany, NY 12203 Fax: (518) 458-6434

Mr. Robert E. Owen, Chief
Bureau of Radiological Health
Ohio Department of Health
35 East Chestnut Street
P.O. Box 118 Tel: (614) 644-2727
Columbus, OH 43266-0118 Fax: (614) 644-1909

Mr. Mike Broderick, Env. Prg. Adm.
Radiation Protection Division
Consumer Protection Service
State Department of Health
1000 N.E. 10th Street Tel: (405) 271-7484
Oklahoma City, OK 73117-1299 Fax: (405) 271-3458

Ms. Martha G. Dibblee, Manager
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800 N.E. Oregon Street Tel: (503) 731-4014
Portland, OR 97232 Fax: (503) 731-4081

Mr. Stuart R. Levin, Chief
Bureau of Radiation Protection
Department of Environmental Resources
Fulton Building, 16th Floor
Third & Locust Streets Tel: (717) 787-3720
Harrisburg, PA 17120 Fax: (717) 783-8965

Mr. Charles McMahon, Supervisor
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206 Cannon Building, 3 Capital Hill Tel: (401) 277-2438
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2600 Bull Street Tel: (803) 737-7407
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445 East Capital Tel: (605) 773-3364
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Texas Department of Health
1100 West 49th Street Tel: (512) 834-6688
Austin, TX 78756-3189 Fax: (512) 834-6690

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Salt Lake City, UT 84114-4850 Fax: (801) 531-8128

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Cheyenne, WY 82002-0710 Fax: (307) 777-5402